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A SURVEY OF ACTIVITIES OF AIRCRAFT MAINTENANCE PERSONNEL.(U)
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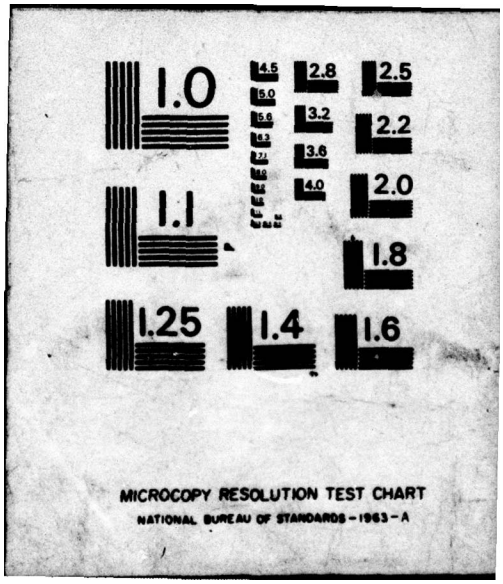
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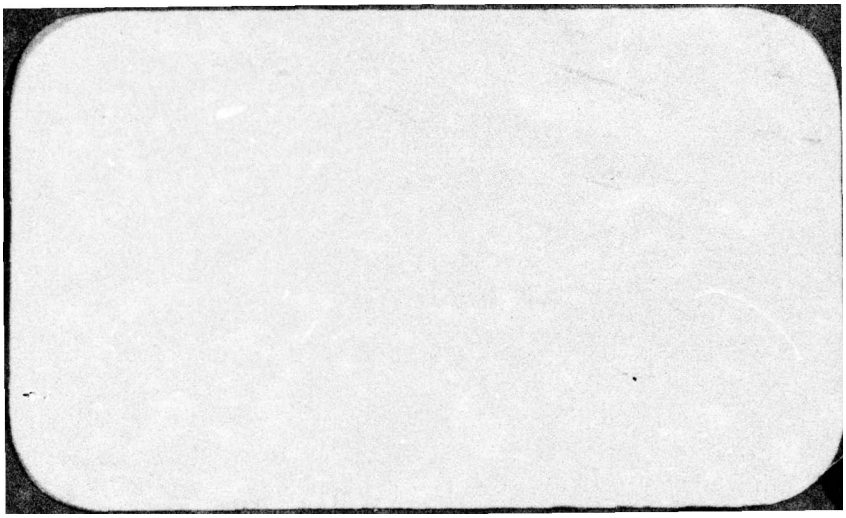

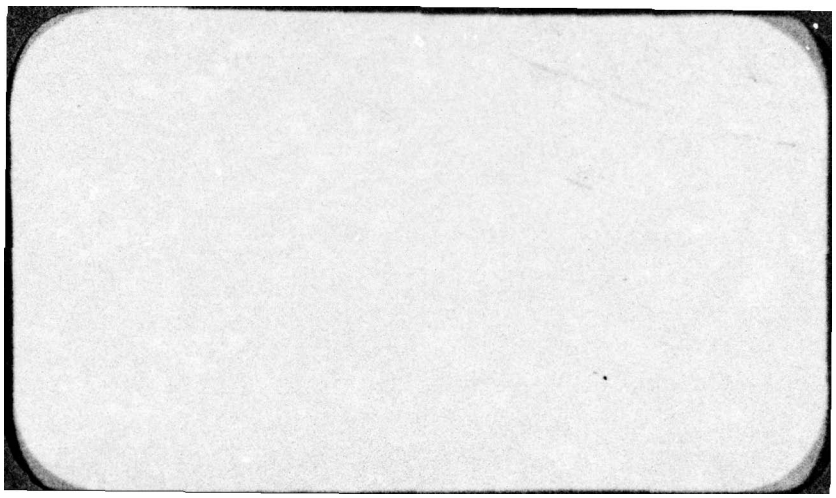

Research Memorandum

A SURVEY OF ACTIVITIES OF AIRCRAFT MAINTENANCE PERSONNEL

by

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Washington, D. C.

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Army Aircraft Maintenance Personnel
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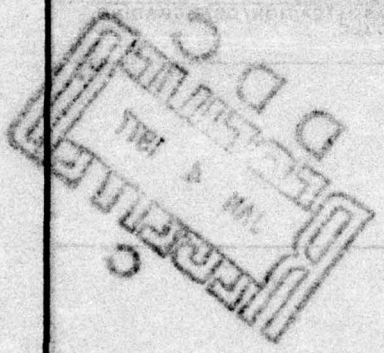
The objective of this study was to obtain detailed information concerning the duty activities of Army Aircraft maintenance personnel. The data would serve as a basis for course modifications which would relate school training as closely as possible to actual job requirements. A comprehensive field survey of approximately 2,500 aircraft maintenance personnel was conducted. The principal objective of the survey was to determine in detail the requirements of the job in the field so that training courses might be tailored, (continued)

20. Continued...

as closely as possible to those requirements.

Some of the findings were as follows:

(1) The typical man, both in organizational and field maintenance, estimated that he spent about two-thirds of his duty time engaged in aircraft maintenance or repair.
(2) Organizational and field maintenance personnel were not appreciably different on any of the background characteristics examined, and
(3) The intention to reenlist in the Army was significantly more common among organizational than among field maintenance personnel.



COMPOSITION OF THE RESEARCH TEAM

Task RAMP was initiated while Dr. William A. McClelland was Director of Research, Training Methods Division. Dr. Arthur J. Hoehn was Director of Research during the preparation of this report.

Dr. David Angell was task leader during the planning and data gathering stages; Dr. George H. Brown, during the data analysis and report writing stages. Mr. Robert E. Anneser participated in the planning, data gathering, and data analysis stages. Miss Elizabeth W. Niehl and Miss Jeannette Rayner assisted in the data analysis and report writing stages.

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SUMMARY AND RECOMMENDATIONS

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The objective of this study was to obtain detailed information concerning the duty activities of Army aircraft maintenance personnel. The data would serve as a basis for course modifications which would relate school training as closely as possible to actual job requirements.

Background

The field of Army aviation has been expanding rapidly in recent years, both in number of aircraft in the inventory and in number of man-hours devoted to maintenance. The maintenance work-load is expected to become progressively greater as a result of both increasing usage and increasing complexity of the equipment being developed. The aircraft are likely to be flown more and to become larger and more complicated. It is therefore essential that the limited time and resources available for the training of aircraft maintenance personnel be utilized as effectively as possible.

Method

A comprehensive field survey of approximately 2,500 aircraft maintenance personnel was conducted. Both organizational and field maintenance units were visited in CONUS, USARAL, USAREUR, USARCARIB, & USARPAC. The principal objective of the survey was to determine in detail the requirements of the job in the field so that training courses might be tailored as closely as possible to those requirements.

The reader's attention is called to the fact that in the data

analysis, men were classified as organizational or field maintenance personnel on the basis of the primary MOS which they held rather than the kind of unit to which they were assigned. It was felt that such a breakdown would be most appropriate to the interests of the training schools since it would yield information on what kinds of duties the typical graduate of each course actually did upon leaving school regardless of whether he were assigned to the kind of unit for which his training had prepared him. In other words, this kind of analysis is based upon the assumption that since the schools cannot anticipate the assignments of their graduates, they should orient their training toward those maintenance activities which graduates will most likely be called upon to do rather than toward those activities which they would be required to do if the personnel assignment and work allocation systems functioned perfectly.

Since 15% of those men in the sample who held organizational maintenance MOS's were actually assigned to field maintenance units, and since 23% of those who held field maintenance MOS's were actually assigned to organizational maintenance units, it is not surprising that the data show considerable overlap in the duty activities of the two categories of maintenance personnel. This overlap, of course, does not mean that the maintenance actions carried out in the two kinds of units (organizational versus field maintenance) overlapped appreciably.

Findings

1. The typical man, both in organizational and field maintenance, estimated that he spent about two-thirds of his duty time engaged in aircraft maintenance or repair.

2. The typical man in organizational maintenance estimated that his aircraft related work time was distributed about as follows:

Various prescribed inspections (42%)
Correcting discrepancies in DD Form 781-2 and -3[1] (15%)
Trouble shooting a malfunctioning component or system (6%)
Other (37%)

3. The typical man in field maintenance estimated that his aircraft related work time was distributed about as follows:

Performing accessory changes & Tech Order Compliances (15%)
Correcting discrepancies in DD Form 781-2 and -3 (24%)
Periodic inspections (10%)
Trouble shooting a malfunctioning compcnent or system (9%)
Other (42%)

4. Organizational and field maintenance personnel were not appreciably different on any of the background characteristics examined.

5. The intention to reenlist in the Army was significantly more common among organizational than among field maintenance personnel (35% vs. 26%). This is probably related to the greater opportunity among organizational maintenance personnel to hold jobs which carry flight pay and/or high enlisted rank.

6. With respect to the men who had specialized on each of the nine aircraft investigated, very few maintenance tasks were done with high frequency by either organizational or field maintenance personnel. The few that were done with high frequency were in almost every instance of a routine, relatively simple nature.

7. Almost all tasks listed in the research instruments had been

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1. This phrase refers to the corrective actions taken by maintenance personnel with respect to defects noted by the flight crew before, during, and after flight.

performed at least occasionally by small percentages of the men.

8. Organizational maintenance personnel were somewhat more active than field maintenance personnel in carrying out inspections, ground handling operations, clerical activities, and tasks involving the airframe, oil system, and the electrical system.

9. Field maintenance personnel were somewhat more active than organizational maintenance personnel in tasks involving the landing gear, ignition system, air induction & exhaust system, and controls. All but nine of the tasks on which the repairmen exceeded the mechanics were authorized organizational maintenance responsibilities.

10. Organizational maintenance mechanics were much more active than one would expect, in the performance of 3rd and 4th echelon tasks. Possible explanations for this overlap in the activities of organizational and field maintenance personnel are considered on pages 56-59 of the report.

11. The topic of instruction judged most valuable for maintenance by graduates of the Aircraft Component Repair Helper course and also by graduates of the Aircraft Maintenance Entry course was "Identification of minor engine malfunctions and trouble shooting." Both groups of men also considered as having great value for maintenance those topics concerned with the use of technical information sources.

Recommendations

1. That the detailed field study data be examined by training authorities for the contribution they can make to the establishment of

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proper training content and relative emphasis for this content.[2]

2. That Aviation maintenance authorities consider the implications of the finding that men holding organizational maintenance MOS's were much more active than one would expect in performing tasks officially regarded as field maintenance responsibilities. Some of the conditions which may account for this fact and some of its possible implications are discussed on pages 56-59.

3. That the topics of instruction in the helper courses which were judged by maintenance men to be especially valuable or especially lacking in value for maintenance be carefully examined to insure that they are being taught in the optimal manner and that their continued presence in the course is warranted.

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2. The U. S. Army Aviation School has already accomplished certain changes in course content and subject matter presentation as a result of interim briefings on RAMP findings.

Chapter 1

INTRODUCTION

The Military Problem

The military problem to which this research study is directed is the growing need for highly skilled aircraft maintenance personnel. That the need is a growing one is evident from the rate at which Army aviation is expanding, and from the increasing complexity of the equipment being developed. It has been estimated[1] that by 1962 the Army's aircraft inventory will have increased by 33% over its 1958 level. At the same time that this inventory increase is taking place, the annual number of man hours devoted to aircraft maintenance is expected to increase by as much as 90%. This difference between a 33% hardware increase and a 90% maintenance workload increase is a result of both increasing usage and increasing complexity of the equipment; the aircraft are being flown more and they are getting larger and more complicated. In addition to these considerations is the long recognized and obvious fact that an in-flight malfunction due to faulty maintenance can result in the loss of life as well as the loss of hundreds of thousands of dollars worth of equipment. Thus, it is extremely important to the Army to have available a large number of highly skilled specialists in aircraft maintenance and repair.

The Research Problem

The objective of this research project is to develop materials with

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1. Presentation by representative of Office, Chief of Transportation at Training and Instructors Conference for 1958 held at the U. S. Army Aviation School, Fort Rucker, Alabama.

which to improve the training of aircraft maintenance personnel. Experience in other HumRRO training research studies has suggested that as a first step in such a project it would be useful to conduct a comprehensive field study of the duty activities of aircraft maintenance personnel. A careful delineation of the requirements of these jobs in the field should make it possible to tailor the training programs very closely to those requirements. This would, of course, lead to better trained men who would require less on-the-job training than is required by current course graduates. It is entirely conceivable that this approach will also lead to a reduction in the length of current training courses.[2] Accordingly, a decision was made to conduct an intensive field study of the activities of aircraft maintenance personnel. In this report, the findings of the field study are presented and their implications are discussed.

The specific objectives of the field study were:

(1) To obtain information concerning the background, (aptitudes, interests, and experience) of aircraft maintenance personnel.

(2) To obtain information concerning the frequency with which organizational and field maintenance personnel perform a wide variety of maintenance jobs on each of the nine most numerous aircraft in the Army's inventory.

(3) To obtain evaluations from repair personnel of the adequacy of

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2. The U. S. Army Aviation School reduced the length of certain of its courses prior to completion of the RAMP study. The findings of RAMP have validated these previously made changes.

the training they had received in the entry courses.

(4) To obtain information concerning the frequency of various equipment malfunctions.

The Sample

Data were collected from a large sample (N = 2,491) of aircraft maintenance personnel assigned to a wide variety of units in CONUS, USARAL, USARCARIB, USAREUR, and USARPAC. Table 1 shows the distribution of personnel contacted by type of unit and by echelon of maintenance. Only units having maintenance responsibility for at least five aircraft were considered for inclusion in the study.

Within each command except CONUS, sampling was virtually exhaustive, with over 90% of all relevant units being visited. Within CONUS, the number of units was so large that exhaustive sampling was not practical nor was it necessary. Instead, all CONUS units were grouped into the various categories listed in Table 1 and a sample of the units in each category was made. At each unit visited, information was obtained from all enlisted personnel present for duty who held an MOS in the general area of aircraft maintenance and who were actually working in that area.[3]

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3. An additional 278 men completed only one of the research instruments: the Background Information Form. The vast majority of these men had done no work related to aircraft maintenance and were therefore not required to complete the other forms. A few of these men had been in their present units only a very short time and were considered to be unqualified to complete the other forms. None of these 278 men is included in the data analyses on which this report is based.

Table 1

Distribution of Personnel Contacted by Type of Unit and Echelon of Maintenance

Type of Unit	Number of Units Contacted	Number of Men Holding MOS in:	
		Organizational Maintenance	Field Maintenance
Organizational Maintenance Units			
Division Aviation Companies	11	394	123
Miscellaneous Aviation Companies	5	99	16
Medical Detachment (Hel. Amb. Units)	8	44	14
Misc. Flight Detachments & Sections	16	142	29
Transportation Companies and Battalions (Helicopter)	13	479	84
Field Maintenance Units			
Transportation Detachments (CH FM)	6	36	165
Transportation Companies (AAM & AABM)	10	82	457
Miscellaneous Field Maintenance Organizations	7	87	240
Totals:	76	1363	1128

Table 2 describes the MOS structure in this area at the time the survey was conducted. Although this MOS structure has since been modified somewhat, the RAMP data are analyzed in such a way that their usefulness will not be compromised by these changes.

Research Instruments

Data were obtained concerning the background characteristics of the aircraft maintenance personnel, the nature and frequency of their job activities, and their evaluations of the adequacy of training they had received in their entry course. These data were obtained through the use of the following questionnaires and checklists:

The Background Information Form was used to obtain information from personnel concerning their pre-Army training and experience, their Army training and duty assignments, on-the-job training, and career plans with respect to the Army and to aircraft maintenance. This information was needed for use in the sample description and in the analysis of maintenance activities. This form was administered to all men in each unit visited who held an MOS in the 67 or 68 series, regardless of whether they were actually working in their MOS.[4]

The Maintenance Activities Check Lists were designed to determine (a) the frequency with which each of a large variety of specific maintenance tasks had been performed during a three-month period, and (b) whether while performing each task, the man had usually functioned as a helper, as an independent repairman, or as a supervisor. A total of

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4. cf footnote on page 3.

Table 2

MOS Structure in Aircraft Maintenance
Area at Time of Field Study

Organizational Maintenance MOS's:	
670.0	Aircraft Maintenance Crewman
671.1 or .6 *	Airplane Mechanic
672.1 or .6	Reconnaissance Helicopter Mechanic
673.1 or .6	Single Rotor Helicopter Mechanic
674.1 or .6	Tandem Rotor Helicopter Mechanic
Field Maintenance MOS's:	
671.2, .3, or .7	Airplane Repairman
672.2, .3, or .7	Reconnaissance Helicopter Repairman
673.2, .3, or .7	Single Rotor Helicopter Repairman
674.2, .3, or .7	Tandem Rotor Helicopter Repairman
680.0	Aircraft Components Repair Helper
681.1 or .2	Aircraft Engine Repairman
682.1 or .2	Aircraft Carburetor Repairman
683.1 or .2	Aircraft Power Train Repairman
684.1 or .2	Rotor and Propeller Repairman
685.1 or .2	Aircraft Electrician
686.1 or .2	Airframe Repairman
687.1 or .2	Aircraft Hydraulic Repairman
688.1 or .2	Aircraft Instrument Repairman

* The meaning of the skill digits is explained on the following page.

Note: With reference to all MOS's in the 67 series, the skill digits (the digit immediately following the decimal point) have the following significances:

.0 Organizational Maintenance Helper

.1 Organizational Maintenance Mechanic

.2 Field Maintenance Repairman

.3 Field Maintenance Technical Inspector

.6 Organizational Maintenance Supervisor

.7 Field Maintenance Repair Supervisor

seven separate Check Lists were employed in the survey but no more than two or three were administered to any one man. One of the seven, The Common Maintenance Activities Check List (MACL) consisted of 231 items (such as "calibrates instruments" and "replaces battery") which would be applicable to any type of Army aircraft. An additional 41 items were applicable only to rotary wing aircraft. The Common Check List was administered to all men in each unit who carried a relevant MOS and who indicated having performed at least some work related to aircraft maintenance during the preceding three-month period. The six other check lists, the Specific Check Lists, (S MACL's) each contained items specific to one aircraft or to a pair of related aircraft; namely:

L-19, L-20	Fixed Wing Reconnaissance and Utility Aircraft
L-23	Command Aircraft
U-1A	Fixed Wing Tactical Transport Aircraft
H-13, H-23	Reconnaissance Helicopters
H-19, H-34	Utility and Cargo, Single Rotor Helicopters
H-21	Light Cargo, Tandem Rotor Helicopter

Each of these forms was filled out by all men in each unit who indicated that they had worked primarily on one of these aircraft (or pairs of aircraft) during the previous three months. Men who had distributed their work over a wide variety of aircraft were not required to fill out a Specific Check List.

In filling out these forms, each man marked appropriate columns to indicate whether, during the previous three months, he had performed the task "never," "one or two times," "three to five times," "six to ten

times," or "more than ten times." It is apparent that this system for determining frequency of task performance relied upon the mens' memories which, of course, were not infallible. However, there is no reason to believe that any systematic errors were introduced by this method. Overestimates made by some men would tend to be compensated for by underestimates made by others. It is believed, therefore, that the percentages of men who checked each response category are reasonably accurate indications of the actual frequency with which each task was performed. It should also be noted that the Maintenance Activities Recording Form (which is described below) provided objective data which were consistent with the Check List findings.

The maintenance activities listed in each of the check lists were derived from the Maintenance Allocation Charts for the particular aircraft concerned and from discussions with personnel at the U. S. Army Aviation School. The items on each of the Specific Check Lists, together with the items on the Common Check List, constitute what is believed to be an exhaustive list of all organizational and field level maintenance tasks which might ever be required on a particular aircraft type. Fifth echelon tasks were not included on the check lists since, at the time of the field study, virtually all such work was being performed by civilian contract personnel.

The School Subjects Check List was designed to obtain the judgments of field personnel concerning the value of each topic of instruction contained in the 670.0 course (Aircraft Maintenance Entry) taught at Fort Rucker and the 680.0 course (Aircraft Component Repair Entry) taught at

Fort Eustis. This form was given to all men in each unit who had attended either of these courses.[5]

The first section of the form listed all topics of instruction common to both courses. The second and third sections, respectively, listed the topics unique to the 670.0 course and those unique to the 680.0 course. Each subject, of course, answered only those items pertaining to the particular course he had taken.

With respect to each topic of instruction the subject indicated by appropriate check marks: (1) how valuable for maintenance he considered that topic to have been and (2) whether he considered the amount of time allotted to that topic to have been too much, too little, or about right.

The Maintenance Activities Recording Form was designed to obtain objective information concerning the nature and frequency of maintenance tasks performed on each type of aircraft involved in this study. Four enlisted men, each an experienced aircraft maintenance man, accompanied the RAMP research team and systematically observed maintenance activities being performed at the flight line or in the shop at each unit visited. For each maintenance task observed, a notation was made on the Maintenance Activity Recording Form, as to the type of aircraft involved, the system and part involved, and the nature of the corrective action.

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5. Although the 680.0 course was discontinued some time after the field study was initiated, the School Subjects Check List data obtained from graduates of that course were analyzed nevertheless since the training authorities at the Transportation School felt that this information would be of use to them in evaluating their Advanced courses.

These observations were made only in the USAREUR phase of the study since the four enlisted men who made the observations were not available to HumRRO for the subsequent phases.[6]

The Questionnaire for Aircraft Maintenance Officers was designed to obtain information concerning the operation of maintenance units, amount and kind of on-the-job training provided, and officers' suggestions for improving training. One copy of this questionnaire was left with the maintenance officer of each unit visited with instructions that it be filled out and mailed directly to HumRRO. A total of 46 completed forms were received and processed.

Methods of Data Analysis

Worldwide Samples

Although the job activities of aircraft maintenance personnel may vary as a function of the theater to which they are assigned, the training schools cannot anticipate the assignments of their graduates and must therefore prepare them to work in any type of aircraft unit in any theater. For this reason, the field study data were not analyzed separately by theater. Data obtained with each of the research instruments were analyzed on a world-wide basis.

Since the sampling in all theaters except CONUS was virtually exhaustive whereas the CONUS sampling was much less extensive, it was

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6. These men were assigned to the Work Measurement Branch, Training Literature Department, the Transportation School, Fort Eustis. Their services were made available to HumRRO for a limited period of time.

necessary to weight the CONUS data before incorporating them within the worldwide sample.

Accordingly, weights were applied to the CONUS data, separately for each kind of unit, in such a way that the influence of these data upon the worldwide population findings would be approximately equivalent to what it would have been had the sampling in CONUS been exhaustive. The number of men actually contacted in the worldwide population was 2491. After weighting the CONUS data, the projected worldwide N is 3975.

Throughout the remainder of this report, whenever an indication is given of the number of subjects who supplied data for a certain table or who had a certain background characteristic, the number given is the projected number, which takes into account the weighting previously applied to CONUS data.

Organizational Maintenance vs. Field Maintenance Personnel

The two principal consumers of the RAMP field study findings are the U. S. Army Aviation School, Fort Rucker, Alabama (concerned with the training of organizational maintenance personnel) and the U. S. Army Transportation School, Fort Eustis, Virginia, (concerned with the training of field maintenance personnel). It is therefore appropriate that data be presented separately for organizational maintenance MOS's and field maintenance MOS's. It would not be sufficient merely to separate the men on the basis of whether their unit has an organizational or a field maintenance responsibility because of the fact that both kinds of units contain both categories of MOS. (This fact is evident in Table 1.) About 80% of the men in each MOS category are assigned to units at the

appropriate echelon of maintenance. In Chapter 2, concerned with background characteristics of the men, separate descriptions are given for these two categories of men. Finer breakdowns of the background data were considered unnecessary.

Breakdown of the Data by Aircraft

In the analyses of the Maintenance Activities Check List data, reported in Chapters 3 and 4, data are grouped according to the type of aircraft on which the subject reported that he had principally worked. The vast majority of the men indicated that they had worked principally on one particular aircraft type. Some indicated that they had divided their time fairly evenly between two related aircraft such as L-19 and L-20, H-13 and H-23, or H-19 and H-34. Such men are referred to as "Duals." The Common Maintenance Activities Check List data of such men were treated twice, i.e., these men were regarded as members of two different aircraft groups.

An example may clarify the way in which Duals were handled in the data analysis. A man who had divided his time fairly evenly between L-19 and L-20 aircraft would be called an L-19, L-20 Dual. He would have submitted a single Common MACL which would be processed twice, once as a part of the L-19 data and once as a part of the L-20 data. He would also have submitted a single Specific MACL booklet covering the maintenance activities specific to each of these aircraft. In this booklet he would have responded to each item twice, once with respect to L-19 and once with respect to the L-20. His L-19 Specific data were grouped for analysis with those supplied by the "pure" L-19 men, and his L-20

Specific data were grouped with those supplied by the "pure" L-20 men.[7]

A few men in the sample indicated that they had distributed their work time over a wide variety of aircraft and were therefore unable to identify a single aircraft or pair of aircraft on which they had specialized. Such men were not required to submit a Specific MACL. These men are referred to as "Generalists." Their Common MACL data are analyzed without regard to type of aircraft on which they had worked.

Supervisory Status

After breaking down the Maintenance Activities Check List data by aircraft affiliation, the next and final break was by supervisory status, i.e., by whether a man was a helper, an independent mechanic or repairman, or a supervisor. (In the field maintenance area, technical inspectors were regarded as having a supervisory position.)

Summary of Data Breakdown Employed with each Research Instrument Background Information Form

Separate analyses were made of the Organizational Maintenance MOS's and the Field Maintenance MOS's.

Maintenance Activities Check List. Data were broken down successively by (1) Organizational vs. Field Maintenance MOS's, (2) by type of aircraft principally worked on, and (3) by supervisory status.

Maintenance Activities Recording Form. Data were broken down

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8. One might question the appropriateness of treating Dual men as though they were full-time members of two aircraft groups. A special analysis, however, showed that the data provided by the Dual men working on a certain type of aircraft were substantially the same as those provided by men who had worked exclusively on that type aircraft.

successively by (1) type of aircraft upon which the maintenance activity was performed, (2) by system and subsystem involved, and (3) by nature of corrective action.

School Subjects Check List. Data were broken down into two groups: (1) all men who had taken the 670.0 course, and (2) all men who had taken the 680.0 course.

Chapter 2

CHARACTERISTICS OF THE MEN

The background, military status, and other characteristics of Army aircraft maintenance personnel are described in this chapter. Most of this information was obtained through the use of the Background Information Form, described on page 5. At each unit visited, this form was administered to all enlisted personnel present for duty who held an MOS in the 67 or 68 series. Men who were not actually working in the general area of aircraft maintenance are not included in the description presented in this chapter.

With respect to each characteristic considered, information is presented separately for the entire population of Organizational Maintenance MOS's (N = 2319) and the entire population of Field Maintenance MOS's (N = 1656).

Background Characteristics

Civilian Education

Information on the civilian schooling of the men is given in Table 3. Marked similarity of the two groups of men is apparent. Approximately two-thirds of each group had a high school education or the equivalent thereof. Thirteen per cent of each group had attended college.

Pre-Army Mechanical Experience

Amount of pre-Army experience in mechanical maintenance work which the men had had either as work or as a hobby is summarized in Table 3. A surprisingly large percentage of both groups reported having had a great deal of such experience. It seems likely that such men would have a

Table 3

Civilian Education and Mechanical Experience

ITEM	PERCENTAGES Org. Maint. MOS's (N = 2319)	Field Maint. MOS's (N = 1656)
Formal education:		
Completed 8 grades or less	8	6
Attended high school	14	15
Graduated from high school (or equivalent)	63	64
Attended college	13	13
Some relevant technical training or trade school experience	15	15
Pre-Army mechanical experience as work or hobby:		
A great deal	58	56
Some	26	26
Very little or none	16	18
Held job in mechanical maintenance	7	7

favorable attitude toward their aircraft maintenance training and their subsequent work assignment.

Aptitude Area Scores

At each unit visited Army Classification Battery and Aptitude area scores were obtained for all men in the unit holding MOS's in the 67 and 68 series regardless of whether they were present for duty or whether they completed any of the RAMP questionnaires. Such data were obtained for a total of approximately 3500 men. Table 4 shows the mean scores in selected Aptitude Areas for various groups of MOS's. Only those Aptitude Areas which were judged to be relevant to aircraft maintenance work are reported in Table 4. These are General Maintenance (GM), Motor Maintenance (MM), and General Technical (GT).

Differences among MOS groups in means scores are, in general, rather small. The 670.0's and 680.0's generally score somewhat lower than the others but this is to be expected since it is customary to send the more able graduates of the entry courses on to more advanced courses where they, of course, acquire a different MOS.

It is interesting to note that the mechanics score slightly higher on MM than do the repairmen. The differences are quite small, however, and are probably not significant. It is not surprising to find that both organizational and field supervisors score higher on MM than do their respective subordinates. It is noteworthy that for nearly all MOS's the mean scores on MM are considerably above 100, the minimum required for admission to any of the aircraft maintenance courses offered at Fort Rucker and Fort Eustis.

Table 4

MEAN APTITUDE AREA SCORES

MOS Group		N	Aptitude Area		
			General Maintenance	Motor Maintenance	General Technical
Org. Maint. Helpers	670.0	390	109	112	104
Org. Maint. Mechanics	671.1	427	114	116	109
	672.1	250	115	118	110
	673.1	394	116	118	111
	674.1	218	113	117	108
Org. Maint. Supervisors	671.6 672.6 673.6 674.6	263	113	119	109
Field Maint. Repairmen	671.2	275	112	115	108
	672.2	149	114	115	111
	673.2	403	115	115	110
	674.2	182	113	115	108
Field Maint. Supervisors	671.3 or .7 672.3 or .7 673.3 or .7 674.3 or .7	187	117	121	113
Component Rep. Helpers	680.0	61	111	115	106
All other Component Repairmen	681.1 or .2 682.1 or .2 683.1 or .2 684.1 or .2 685.1 or .2 686.1 or .2 687.1 or .2 688.1 or .2	378	114	113	109
	Total N =	3577			

Military Status

Various military characteristics of the men are summarized in Table 5. Both groups contain very high percentages of Regular Army (RA) personnel although the percentage is significantly higher for the field maintenance group than for the organizational maintenance group. This may be due to the fact that field maintenance courses tend to be somewhat longer than organizational maintenance courses.[8]

The typical man in each group had been in the service for about two years and had slightly more than one year of service remaining before he would reach the end of his current tour of duty.

Army Aircraft Maintenance Training

School Training

Summarized in Table 6 are the percentages of men in each group who had attended each of the different aircraft maintenance courses taught at the U. S. Army Aviation School, Fort Rucker, or at the U. S. Army Transportation School, Fort Eustis.

As would be expected, Fort Rucker courses had been taken primarily by organizational maintenance personnel and Fort Eustis courses, by field maintenance personnel.

It is somewhat surprising that only 56% of the organizational men had taken the 670.0 course which is listed as a prerequisite for all the

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8. AR 611-215 prescribes certain minimal amounts of remaining service time as prerequisites for enrolling in courses of various lengths. Most of the aircraft maintenance courses, particularly the field maintenance courses, are of such a length that few draftees would be eligible for enrollment.

Table 5

MILITARY STATUS

CHARACTERISTIC	Org. Maint. MOS's (N = 2319)	Field Maint. MOS's (N = 1656)
Enlistment Status		
Regular Army*	71%	82%
Other (Draftee, National Guard, or Reserve)	29%	18%
Rank		
Median	E-4	E-4
Range	E-2 E-7	E-2 E-7
Army Service		
Median number of months in service	23.7	25.8
Median number of months in present job	7.6	7.8
Median number of months until discharge or end of tour of duty	15.0	14.1

* The groups differ significantly on this characteristic.

Table 6

AIRCRAFT MAINTENANCE COURSES ATTENDED[1]

(Percentages)

Course	Org. Maint. MOS's (N=2319)	Field Maint. MOS's (N=1656)
Fort Rucker Courses:		
670.0 Aircraft Maintenance (Entry)	56	23
671.1 Airplane Maintenance	16	5
672.1 Recon. Hel. Maintenance	6	3
673.1 Utility & Cargo Single Rotor Hel. Maint.	8	3
674.1 Utility & Cargo Tandem Rotor Hel. Maint.	11	8
Other advanced courses at Ft. Rucker	1	2
Fort Eustis Courses:		
680.0 Aircraft Component Repair Helper	3	38
671.2 Airplane Repair	1	7
672.2 Recon. Hel. Repair	1	7
673.2 Utility & Cargo Single Rotor Hel. Repair	1	7
674.2 Utility & Cargo Tandem Rotor Hel. Repair	1	11
681.1 Aircraft Engine Repair	1	2
682.1 Aircraft Carburetor Repair	1	1
683.1 Aircraft Powertrain Repair	1	1
684.1 Aircraft Rotor & Propeller Repair	0	1
685.1 Aircraft Electrical Repair	0	1
686.1 Aircraft Airframe Repair	1	6
687.1 Aircraft Hydraulic Repair	1	1
688.1 Aircraft Instrument Repair	1	1
Other advanced courses at Ft. Eustis	1	2

1. The course numbers used in this table are based on the MOS system in use at the time the data were collected. The MOS system has since been changed somewhat.

more advanced Rucker courses. Probably at least some men were awarded an MOS in organizational maintenance on the basis of on-the-job training rather than school training. Others received their MOS on the basis of courses taken at Air Force Bases.

Aside from the 670.0 course, the Rucker course taken by the greatest percentage (16%) of the organizational men was the Airplane Maintenance course (MOS 671.1). It seems probable that the percentages of men who had taken each of the Rucker courses are roughly proportional to the number of aircraft of each category in the Army's inventory. Only minute percentages of the organizational men had taken each of the Eustis courses.

With respect to the field maintenance personnel, 23% had taken the 670.0 course and 38% had taken the 680.0 course.[9] It would appear that about 40% of the field maintenance personnel had taken neither entry course. Presumably these men had been awarded their MOS on the basis of on-the-job training.

About half of the field maintenance men had attended some advanced course at Fort Eustis. Of these, the number attending 67 series courses was about double the number attending 68 series courses. In fact, it is rather surprising to note the extremely small percentages of men who had attended each of the advanced 68 series courses. This is undoubtedly related to the fact that relatively few component repair specialists are

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9. The 680.0 course was discontinued in July 1958. Most of the content of that course was added to the various advanced courses taught at Fort Eustis.

utilized in the Army Aircraft maintenance system.

A few other findings concerning the school training of the men are not shown in Table 6. About half of the members of each group who had taken an advanced course reported that they would rather have taken a different course. About one-fourth of the members of each group had attended an aircraft maintenance course at some place other than Fort Rucker or Fort Eustis. These "other" courses were principally lower echelon maintenance courses taught at various U. S. Air Force bases and at Fort Sill, Fort Benning, Fort Bragg, and various other Army installations. About eight per cent of each group had received factory training in aircraft maintenance or repair while in the Army. About six per cent of each group had taken extension or correspondence courses in subjects related to their MOS.

On-the-Job Training (OJT)

Table 7 provides information concerning the OJT received by aircraft maintenance personnel. Significantly more organizational men (48%) than field men (43%) had, at some time in their careers, attended OJT classes in aircraft maintenance or repair taught by personnel in their unit. The personnel teaching the classes were generally commissioned or warrant officers, civilian technical representatives, or enlisted maintenance supervisors.

Seventeen and 10% of the Organizational and Field Maintenance groups respectively were currently attending such classes at the time of the research team's visit. The vast majority of men in both groups felt that regular OJT classes would be helpful to them in acquiring additional

Table 7

ON-THE-JOB TRAINING

(Percentages)

ITEM	ORG. MAINT. MOS's (N = 2319)	FIELD MAINT. MOS's (N = 1656)
Had attended at least some OJT classes*	48	43
Were currently attending OJT classes	17	10
Felt OJT classes would be helpful	87	85
Had attended OJT classes taught by:		
Commissioned or Warrant Officers	7	7
Civilian Technical Representatives	4	5
Enlisted Maintenance Supervisors	9	10
Other Experienced Personnel	7	7
Various combinations of the above	21	13

* The groups differ significantly on this characteristic.

information and skills needed for their jobs.

Military Work History

The typical man in both Organizational and Field maintenance had been in the Army about two years. Of that time he had spent about 14 or 15 months in jobs having to do with aircraft maintenance. He had been in his present assignment about eight months. He had spent 3-5 months in overseas assignments having to do with aircraft maintenance.

About 50% of the men had had their present MOS for a year or more. Fifteen to 20% had held their present MOS for more than two years.

Duty positions occupied by the men are indicated in Table 8. Among the Organizational MOS's, Crew Chief was the most common duty position; among the Field MOS's, Repairman was the most common duty position.

It is possible that some of the men had an erroneous notion as to the duty position they held. According to AR 611-201 (The "MOS book") the job of Crew Chief is ordinarily filled by Organizational maintenance MOS's and yet 13% of our Field Maintenance MOS's indicated that they were holding such a duty position. Similarly, the job of Technical Inspector is supposedly a Field Maintenance duty position, yet one per cent of our Organizational Maintenance MOS's indicated that they held this job. It is also possible that some men were assigned to duty inappropriate to their MOS because of the unavailability of personnel having the required MOS.

Men in the sample were asked to estimate what percentage of their duty time during the previous three months had been spent in various activities. Mean percentages are presented in Table 9. The average man

Table 8

DISTRIBUTION OF PERSONNEL BY DUTY POSITION

(Percentages)

DUTY POSITION	Org. Maint. MOS's (N = 2319)	Field Maint. MOS's (N = 1656)
Mechanic or Repair Helper	14	6
Mechanic or Repairman	16	36
Senior Mechanic or Repairman	6	18
Crew Chief	41	13
Maintenance Supervisor	9	8
Technical Inspector	1	5
Other	10	9
Ambiguous Answers	3	4

Table 9

PERCENTAGES OF TOTAL DUTY TIME
SPENT IN VARIOUS ACTIVITIES

(Mean of Men's Estimates)

ACTIVITY	Org. Maint. MOS's (N = 2319)	Field Maint. MOS's (N = 1656)
Aircraft Maintenance or closely related work	66	63
Company details (KP, CQ, etc.)	9	10
Military Training (marksmanship, etc.)	8	9
Technical Training (OJT and study)	4	5
Miscellaneous (housekeeping, athletics, leave, etc.)	13	13

in each group had spent about two-thirds of his duty time in aircraft maintenance (or in closely related work such as technical supply). This appears to be a reasonably high activity level in view of the fact that previous HumRRO studies (of various MOS's outside of the aircraft maintenance field) found the average man to be spending much smaller amounts of time in work appropriate to his MOS.

It may be of some interest to note that in a special analysis of the small sample of men in USARCARIB (N = 65), the average man spent 82% of his time in aircraft maintenance work and only 2% of his time in company details. This is due to the fact that in USARCARIB, indigenous labor is hired to do most of the KP and housekeeping functions.

The men were also asked to estimate what percentage of their aircraft maintenance work time was devoted to each of several more specific categories of maintenance activities. The means of the men's estimates are shown in Table 10. As would be expected, the Organizational Maintenance men spent much more time performing routine servicing operations such as washing and lubricating. On the other hand, the field maintenance men spent more time than the organizational maintenance men correcting specific discrepancies in DD Form 781-2 and -3, and in performing aircraft accessory changes and Technical Order Compliances. Neither group spent more than a small amount of time (6 and 9%) in trouble shooting activities.

The categories "Correcting specific discrepancies noted in form DD 781-2" and "Trouble shooting a malfunctioning system or component" probably overlap to some extent. Some defects which are entered on the

Table 10

PERCENTAGES OF AIRCRAFT RELATED WORK-TIME SPENT IN VARIOUS ACTIVITIES

(Mean of Men's Estimates)

ACTIVITY	Org. Maint. MOS's (N = 2319)	Field Maint. MOS's (N = 1656)
Pulling pre-flight or post-flight inspections	24	8
Pulling periodic inspections	15	10
Technical inspections	3	5
Servicing, washing, cleaning aircraft	12	5
Correcting specific discrepancies noted in DD Form 781-2*	15	24
Performing aircraft accessory changes & Technical Order Compliances	6	15
Doing maintenance-related administrative and paper work	7	6
Doing supply or tool-room work	2	3
Trouble shooting a malfunctioning component or system on an aircraft	6	9
Flying	5	2
Other	5	13

* This phrase refers to the corrective actions taken by maintenance personnel with respect to defects noted by the flight crew before, during, and after flight.

DD Form undoubtedly require trouble shooting before they can be corrected, e.g., "vibration when speed exceeds 60 knots" and "engine difficult to start." The majority, however, are of such a nature that the appropriate corrective action is immediately apparent, e.g., "map light missing," "lower door hinge loose," and "nick on trailing edge of red blade."

Table 11 indicates the percentages of men who had worked at least some, during the previous three months, on each of nine different aircraft. These percentages are probably related, to some extent, to the number of aircraft of each type which exists in the Army inventory. In any event, the aircraft which were encountered by the largets percentages of each group were: the L-19, L-20, H-13, and H-21. Relatively small percentages of each group had encountered the L-23, the U-1A, and the H-23.

For most of the aircraft listed in Table 11, the percentages indicated for organizational and field men are rather similar. For the H-13, H-19, H-34, however, significantly larger proportions of field than of organizational men had worked on these aircraft.

Field men had encountered a slightly wider variety of equipment than had the organizational men. The median number of different aircraft encountered by field and organizational men, respectively, was 2.1 and 1.7.

Career Plans

The men's reenlistment intentions are summarized in Table 12. The percentage of men definitely planning to reenlist is significantly greater for the organizational men than for the field men (35% vs. 26%). Among

Table 11

Aircraft Encountered by Maintenance Personnel

	Percentages[1] of Men Having Worked on Aircraft in 3 month period	
	Org.	Field
L-19	34	33
L-20	31	30
L-23	16	15
U-1A	6	9
H-13*	21	34
H-23	6	7
H-19*	13	24
H-34*	15	26
H-21	29	29
Other	2	3

1. Percentages in each column add to more than 100 because many of the men had worked on more than one aircraft.

* Groups differ significantly.

Table 12

Career Plans

Plan	Org. Maint. MOS's	Field Maint. MOS's
Total Samples	(N = 2319)	(N = 1656)
Plan to reenlist*	35%	26%
Plan not to reenlist	46%	57%
Uncertain	19%	17%
Men Planning to Reenlist	(N = 802)	(N = 423)
Plan to stay in aircraft maint.*	95%	90%
Plan to enter a different field	5%	10%
Men Planning Not to Reenlist	(N = 1068)	(N = 938)
Plan to stay in aircraft maint.*	44%	53%
Plan to enter a different field	51%	46%
(Failed to answer, or ambiguous answer)	5%	1%

* Significant at .05 level.

the possible explanations for this fact are the following considerations:

(1) Within organizational maintenance units there is generally a greater opportunity for obtaining flight status (with its accompanying flight pay) and for obtaining relatively high rank (E-6 or E-7).

(2) Perhaps the fact that organizational men frequently serve the user in more direct, or face-to-face manner causes them to derive more satisfaction from their work. Their duties bring them in closer contact with the flying personnel whose personal safety depends upon the quality of the maintenance man's work. Many field maintenance men work in rear echelon shops, quite remote from the flight line.

(3) Another possible explanation for the greater tendency among organizational maintenance personnel to reenlist is that since these men are trained to a lower level than are the field maintenance personnel, they may find it more difficult to obtain attractive jobs in civilian industry.

Among those men who definitely planned to reenlist, a significantly greater percentage of organizational men than field men expected to remain in the aircraft maintenance area. This fact lends support to the idea that organizational men derive more satisfaction from their duties than do field men. It is worth noting, however, that among both organizational and field men who planned to reenlist, the percentage expecting to continue in the aircraft maintenance area is quite high (95% and 90%).

Among those men planning <u>not</u> to reenlist, the percentages who expected to continue in the aircraft maintenance area were much smaller than were those found among men who did expect to reenlist.

Chapter 3

MAINTENANCE ACTIVITIES OF ORGANIZATIONAL MAINTENANCE MOS's

This chapter is concerned with a description of the maintenance activities of men holding an MOS in organizational maintenance. It should be noted that such men may be assigned either to aviation units authorized to perform only organizational maintenance, or to units having a field maintenance mission. In the field study, as would be expected, the vast majority of these men were assigned to organizational maintenance units. All data reported in this chapter were obtained through the use of the Maintenance Activities Check Lists, described in Chapter 1.

As was explained on page 12, the CONUS data were weighted to make their influence on the worldwide population findings approximately what it would have been, had sampling in CONUS been exhaustive. Therefore, the N's (representing number of subjects) which appear in this chapter, are not to be interpreted literally. The number of men actually contacted was usually somewhat smaller.

Since the quantity of data yielded by the Maintenance Activities Check Lists, Common and Specific, is extremely voluminous, it was not considered desirable to present them in their entirety in this report. Instead, only the most important findings are presented, selected according to various criteria which will be described in appropriate sections of this chapter. The complete findings have already been presented informally to training authorities at the U. S. Army Aviation School and at the U. S. Army Transportation School.

This chapter is organized as follows: The first group of men to be

considered consists of all organizational mechanics, i.e., all men who held one of the following MOS's: (671.1, 672.1, 673.1, or 674.1). All such mechanics are organized into subgroups on the basis of the particular type of aircraft on which they have worked most. Next, all organizational maintenance helpers (MOS 670.0) contacted in the study, without regard to the type of aircraft they worked on will be considered. Finally, all organizational maintenance supervisors (MOS's 671.6, 672.6, 673.6, and 674.6) will be considered as one group, without regard to the type of aircraft on which they may have specialized.

Mechanics

A total of 1792 Organizational Maintenance Mechanics submitted Common Maintenance Activity Check Lists. This form, it will be recalled, lists 231 maintenance activities which are applicable to any Army aircraft and an additional 41 activities applicable only to helicopters. Those mechanics who had specialized on a particular type of aircraft (N = 1612) also submitted a Specific Check List.

Table 13 condenses the more important findings concerning the duty activities of 682 Fixed Wing Organizational Mechanics. Listed in Table 13 are all tasks which had been performed on at least one type of aircraft 6 or more times during a three-month period by 50% or more of the men. All items came from the Common Maintenance Activities Check List because no task on the Specific Check Lists had been done frequently enough to meet the criterion for inclusion in this table.

The most striking aspect of Table 13 is the fact that it contains so few items. Only 26 out of a possible 300-400 items met the criterion

Table 13

MOST COMMON MAINTENANCE ACTIVITIES OF FIXED WING ORGANIZATIONAL MECHANICS

(Only tasks performed 6 or more times by 50 per cent or more of the men are included)
(N=682)

Activity	Aircraft L-19 N-326	L-20 N-196	L-23 N-108	U-1A N-52
INSPECTIONS				
Preflight inspections	67	69	100	87
Postflight inspections	78	76	100	87
Periodic inspections				65
AIRFRAME				
Clean interior & exterior	70	66	89	77
Replace inspection plates and covers	78	77		83
General service & lubrication	75	73	56	81
Replace fairings and fuselage cowlings	54	55		65
Clean plexiglass	80	77	97	79
Replace seats, and seat accessories		54		
LANDING GEAR				
Service wheels				50
Clean, inspect, repack wheel bearings	55			58
POWER PLANT, ENGINE				
Replace rocker box covers and gaskets				50
OIL SYSTEM				
Clean and/or replace oil system filters or strainers			54	
Service oil system	65	70	79	69

Activity	Aircraft L-19 N-326	L-20 N-196	L-23 N-108	U-1A N-52
AIR INDUCTION & EXHAUST SYSTEM				
Replace engine cowling engine ducts, exhaust collector sections				50
ELECTRICAL SYSTEM				
Service battery sump jar				54
Service battery and check specific gravity			63	
Use radio telephone procedures		57	65	
OPERATIONS				
Taxi aircraft	59	64	78	62
Perform ground handling operations	67	57	88	79
Clean and maintain shop equipment			46	69
Handle flammable materials	64	58	79	77
Handle fuel handling equipment	52		88	
CLERICAL ACTIVITIES				
Maintain records	70	67	88	63
Identify and tag serviceable and unserviceable parts	53		56	
USING EQUIPMENT				
Safety and inspect for proper safetying	69	68	77	73

for inclusion in the table. It should be noted, however, that virtually all of the tasks listed on the Common Check List had been done one or more times during a three-month period by at least a small percentage of the mechanics.

It appears that for each of the aircraft types, tasks involving the airframe were more numerous than those involving any other system. This may be partly due to the fact that it is often necessary to remove portions of the airframe just to obtain access to other systems in need of maintenance. The Common MACL includes a total of 26 airframe items. The electrical system is represented by a total of 42 items in the Check List, of which only three were done with sufficient frequency to be included in Table 13.

Conspicuous for their absence in Table 13, are activities involving the fuel system and instrument system. This is somewhat surprising, in view of the fact that the Common MACL lists 29 fuel systems and 12 instrument items. Evidently organizational mechanics seldom perform maintenance on these systems. It is probable that these systems are relatively trouble free.

It will be noted that the L-19 and L-20 data look rather similar. For both of these aircraft the most often performed activities were: cleaning plexiglass, replacing inspection plates and covers, general service and lubrication, servicing the oil system, cleaning interior and exterior of airframe, and maintaining records.

For the L-23 and the U-1A, the other two fixed wing aircraft on which data were obtained, pre-flight and post-flight inspections were

done with very high frequency. Surprisingly, however, periodic inspections were done much less frequently on the L-23 than on the U-1A. Other items which were done with high frequency in both aircraft were: cleaning interior and exterior, cleaning plexiglass, servicing the oil system, ground handling operations, handling flammable materials, and safetying and inspecting for proper safetying.

Certain items were done with noticeably higher frequency on the L-23 than on the U-1A. These were: using radio telephone procedures, handling fuel handling equipment, and identifying and tagging parts.

Certain other items were done more frequently on the U-1A than on the L-23. These were: periodic inspections, replacing inspection plates and covers, general service and lubrication, replacing fairings and fuselage cowlings, and servicing battery sump jar.

Table 14, which is closely analogous to the preceeding table, summarizes the findings concerning Rotary Wing organizational mechanics. Again it is noteworthy that so few tasks were done with sufficient frequency to meet the criterion for inclusion in the table. For the H-13, 10 tasks qualified; for the H-23, 16 tasks; for the H-19, 16 tasks; for the H-34, 10 tasks; and for the H-21, 11 tasks. Again we find that "Airframe" accounts for more tasks than does any other system. "Operations" is the next highest ranking category.

Since the H-13 and H-23 are fairly similar aircraft and since they are both taught in the same course, one would expect the maintenance tasks performed on them to be rather similar. Table 14 does show several such similarities but not as many as might be expected. The fact that

Table 14

MOST COMMON MAINTENANCE ACTIVITIES OF ROTARY WING ORGANIZATIONAL MECHANICS

(Only tasks performed 6 or more times by 50 percent or more of the men are included.)

Activity	Aircraft					Generalists
	H-13 N=186	H-23 N=42	H-19 N=105	H-34 N=209	H-21 N=419	N=149
CONTROLS						
Check engine controls		52	50			
INSPECTIONS						
Make preflight inspections			55	71	51	
Make postflight inspections	77	81	76	75	84	54
AIRFRAME						
Clean interior and exterior	78	81	78	70	67	54
Replace inspection plates and covers	66	67	60	62	64	
Perform general service and lubricate aircraft	87	76	82	81	86	58
Replace fairings and fuselage cowlings			65		62	
Clean plexiglass	70	76	73	68	73	61
Remove and install cabin doors		76				
HYDRAULIC SYSTEM						
Service hydraulic system			50			
OIL SYSTEM						
Service oil system	70	71	68	70	77	
IGNITION SYSTEM						
Replace spark plugs		76				
OPERATIONS						
Perform ground handling operations, (leveling, jacking hoisting, towing, mooring, parking of aircraft)	54	57	59	57	62	53
Clean and maintain shop equipment		52				
Handle flammable materials=	55	57	65	58		62
Handle fuel handling equipment		71	50			

Table 14 (cont.)

Activities	Aircraft					Generalists
	H-13 N=186	H-23 N=42	H-19 N=105	H-34 N=209	H-21 N=419	
CLERICAL ACTIVITIES						
Maintain records	61	52	56		52	
USING EQUIPMENT						
Safety and inspect for proper safetying	73	76	71	67	73	
DRIVE SYSTEM (Hel, only)						
Service all gear boxes		67	52			

the H-23 data are based on only 42 cases may vitiate the importance of this observation, however.

For both the H-13 and the H-23, post-flight inspections are made appreciably more often than pre-flight inspections. Why this should be so is not clear. Other items which rank high for both aircraft are: cleaning interior and exterior, general service and lubrication, cleaning plexiglass, servicing oil system, and safetying and inspecting for proper safetying. A number of items were done with much higher frequency on the H-23 than on the H-13. These were: checking engine controls, replacing fairings and fuselage cowlings, replacing spark plugs, handling fuel handling equipment, and servicing gear boxes.

It is evident that almost all the tasks listed in Table 14 are performed more often by H-19 mechanics than by H-34 mechanics. A notable exception is "pre-flight inspections" which were performed more often by H-34 mechanics.

The last group of mechanics to be considered consisted of 149 men who had worked on such a variety of aircraft that they could not identify themselves as having specialized on any particular one. These men are referred to as generalists. Since their experience was so diversified, it is not surprising that very few individual tasks were performed by them with very high frequency. Only six items were done six or more times by at least 50% of the generalists. These were: post flight inspections, cleaning interior and exterior, general service and lubrication, cleaning plexiglass, ground handling operations, and handling flammable materials.

Helpers (MOS 670.0)

A total of 376 Common Maintenance Activities Check Lists submitted by Organizational Maintenance Helpers are included in this analysis. Those of the helpers who had specialized on one type of aircraft also submitted a Specific Check List, but not enough of these were submitted for any one aircraft type to justify analysis of the data. Accordingly, this section of the chapter will be concerned only with the 272 Common Check List items.

Table 15 presents a condensation of the more important findings concerning the maintenance activities of Organizational Maintenance Helpers. Previous tables in this chapter listed only items which had been performed six or more times by at least 50% of the men. Since, for the helper data, no items met this criterion, a more lenient criterion was adopted for selecting items for inclusion in the table. This makes it possible to give the reader some idea of what organizational maintenance helpers included in the study primarily did, even though none of their activities was done with very high frequency.

Table 15, therefore, lists all tasks which were done one or more times by at least half of the helpers. For each item listed, the various columns indicate the exact percentage of the men who had performed the activity one or more times, three or more times, and six or more times. The most striking aspect of Table 15 is the indication that so few jobs were done with appreciable frequency by more than a small percentage of the men. In fact, none of the 272 activities had been done six or more times, and only six had been done three or more times (during a three-

Table 15

MOST COMMON ACTIVITIES OF ORGANIZATIONAL MAINTENANCE HELPERS
(Only tasks performed at least once by 50 percent or more of the men are included)
N=346

System Activity	Per cent Performing: 1 Or more times	3 or more times	6 or more
CONTROLS			
Check engine controls	57	30	14
INSPECTIONS			
Make preflight inspections	54	36	28
Make postflight inspections	59	46	39
Make periodic inspections	55	36	24
AIRFRAME			
Clean interior and exterior	74	55	42
Replace inspection plates and covers	75	61	40
Perform general service and lubricate aircraft	80	63	46
Spot paint aircraft and/or assemblies	54	32	20
Replace fairings and fuselage cowlings	61	48	37
Clean plexiglass	66	53	43
Remove and install cabin doors	55	24	11
Replace seats, and seat accessories (belts, shoulder harnesses, inertia reels, etc.)	55	36	18
LANDING GEAR			
Service wheels	52	23	15
Replace wheels	50	19	9
Clean, inspect, repack wheel bearings	53	24	12
HYDRAULIC SYSTEM			
Service hydraulic systems	52	25	14
OIL SYSTEM			
Clean and/or replace oil system filters or strainers	51	23	12
Service oil system	66	48	35
IGNITION SYSTEM			
Replace spark plugs	57	34	20
AIR INDUCTION AND EXHAUST SYSTEM			
Replace engine cowling, engine ducts, exhaust collector sections	59	35	24
ELECTRICAL SYSTEM			
Replace battery	52	32	19
OPERATIONS			
Perform ground handling operations, (leveling, jacking hoisting, towing, mooring, parking of aircraft)	64	47	37
Clean and maintain shop equipment	58	41	27
Handle flammable materials	67	52	40
Handle fuel handling equipment	50	38	27
USING EQUIPMENT			
Safety and inspect for proper safetying	66	51	38

month period) by 50% or more of the men. These six were: (1) cleaning interior and exterior of aircraft, (2) replacing inspection plates and covers, (3) general servicing and lubrication of aircraft, (4) cleaning plexiglass, (5) handling flammable material, and (6) safetying and inspecting for proper safetying.

Only 26 activities had been done one or more times by 50% or more of the men. Sixty-five per cent of the items on the Check List had not been done at all by 70% or more of the men.

It is apparent that organizational maintenance helpers perform very few maintenance activities. One would expect that many of the very simple, routine tasks such as cleaning, servicing, and lubricating, would be done with very high frequency by helpers. Actually, these tasks as well as many others equally simple, are done more often by mechanics than by helpers. This suggests that helpers and mechanics are not being optimally utilized in the field.

Enlisted Supervisors

Table 16 lists the most common maintenance activities performed or supervised by enlisted organizational maintenance supervisors. In this analysis, all supervisors were treated as one group without taking into account the particular aircraft, if any, on which they had specialized.

Since the supervisors were instructed, in filling out the Check Lists, to count both the instances in which they had performed each task and those in which they had supervised performance, it was expected that this table would contain a fairly large number of tasks. Actually, only 17 tasks met the criterion for inclusion. All of these, incidentally,

Table 16

MOST COMMON ACTIVITIES OF ENLISTED ORGANIZATIONAL MAINTENANCE SUPERVISORS

(Only tasks performed 6 or more times by at least 50% of the men are included)

N = 311

Activity	% Performing 6 or More Times
INSPECTIONS	
Make preflight inspections	59
Make postflight inspections	67
AIRFRAME	
Clean interior and exterior	65
Replace inspection plates and covers	62
Perform general service and lubricate aircraft	70
Replace fairings and fuselage cowlings	57
Clean plexiglass	68
OIL SYSTEM	
Clean and/or replace oil system magnetic plugs, gaskets, drains, fittings, clamps	51
Service oil system	73
OPERATIONS	
Operate, inspect, and service auxiliary ground handling equipment	50
Perform ground handling operations (leveling, jacking, hoisting, towing, mooring, parking of aircraft)	70
Clean and maintain shop equipment	73
Handle flammable materials	73
Handle fuel handling equipment	60
CLERICAL ACTIVITIES	
Maintain records	78
Identify and tag serviceable and unserviceable parts	68
USING EQUIPMENT	
Safety and inspect for proper safetying	85

were also performed frequently by mechanics and helpers. It is evident that even the supervisors perform only a small variety of tasks with high frequency. Virtually every item on the check list, however, had been performed at least occasionally by at least a small percentage of the supervisors.

Thus, it appears that for all categories of organizational maintenance personnel, only a few relatively simple tasks are done with high frequency. It is, of course, possible that some of the infrequently performed tasks are more time consuming than some of the high frequency tasks. It is therefore not possible, on the basis of these data, to draw conclusions as to the amount of time organizational maintenance personnel spend in difficult, as opposed to simple, tasks.

These data do strongly suggest, however, that the total requirement for organizational maintenance of Army aircraft could be adequately met by a structure containing more helpers and fewer mechanics. The helpers would have to be trained specifically to perform the low skill, high frequency tasks and the mechanics could continue to receive the more thorough training which equips them to perform the less frequent but more complex maintenance tasks.

It seems likely that the training costs associated with such a maintenance structure would be substantially less than those associated with the present structure. The detailed frequency data which have been made available to Aviation School authorities should be of considerable assistance in making decisions as to which tasks helpers and mechanics, respectively, should be trained to perform.

Chapter 4

MAINTENANCE ACTIVITIES OF FIELD MAINTENANCE MOS's

This chapter is concerned with a description of the maintenance activities performed by men holding an MOS in field maintenance. As would be expected, the majority of such men encountered in the field study (81%) were assigned to units having a field maintenance mission, although some were assigned to units whose maintenance responsibility was restricted to second echelon activities.

As previously explained, the N's (representing number of subjects) which are reported in this chapter are projected N's based upon the weighted CONUS data. The actual number of subjects who submitted a Maintenance Activities Check List was generally somewhat smaller than the number indicated. Due to the fact that the findings concerning field maintenance personnel and organizational maintenance personnel are highly similar, it is suggested that the reader examine the previous chapter, concerned with organizational personnel, before reading the present chapter.

This chapter is organized as follows: The first group of men to be considered consists of all field maintenance repairmen other than component repairmen. These were organized into subgroups on the basis of the particular type of aircraft on which they had specialized. Next, all field maintenance supervisors (including technical inspectors) will be considered without regard to aircraft specialization. Next, the aircraft component repairmen will be considered. Finally, the

implications of the data presented in Chapters 3 and 4 will be discussed.

Repairmen

Table 17 presents a condensation of the more important findings concerning the duty activities of Field Maintenance Repairmen who had specialized in each of the fixed wing aircraft indicated. Listed in this table are all tasks which had been performed six or more times during a three-month period by at least half of the men. All items appearing in this table except one came from the Common Maintenance Activities Check List. One item, "Check shock strut," came from the L-23 Specific Check List.

The principle observation to be made concerning this table is that it is remarkably similar to its counterpart (Table 13, page 36) which lists the most common activities of fixed wing organizational mechanics. Specifically, (1) It contains remarkably few items (33 out of a possible 300-400). (2) Virtually all the items in this table appear to be quite simple and routine in nature. (3) The categories of "Airframe" and "Operations" are more heavily represented than any others.

Certain minor differences may be noted between the two tables: (1) With respect to the L-20 and the L-23, repairmen perform with high frequency a slightly greater variety of tasks than do the mechanics. (2) With respect to the L-19 and the U-1a mechanics perform with high frequency a greater variety of tasks than do the repairmen.

Table 18 presents a condensation of the most important findings concerning the repairmen who had specialized on each of the Rotary Wing aircraft indicated. It is astonishing to note that only 10 items

Table 17

Most Common Maintenance Activities of Fixed Wing Repairmen

(Only tasks performed 6 or more times by 50 percent or more of the men are included)

Task	Aircraft L-19 N=96	L-20 N=90	L-23 N=36	U-1A N=31
INSPECTIONS				
Preflight inspections		50	94	52
Postflight inspections	64	72	97	58
Periodic inspection			61	
Remove & install cabin doors		53		
AIRFRAME				
Clean interior and exterior	55	66	97	55
Replace inspection plates and covers	78	76	97	74
Perform general service and lubricate aircraft	55	62	67	55
Replace fairings and fuselage cowlings	72	79	94	61
Clean plexiglass	52	62	97	
LANDING GEAR				
Service wheels		56	97	
Replace wheels			97	
Clean, inspect, repack wheel bearings		58	97	
Replace tires and tubes			67	
Check shock strut			64	
POWER PLANT, ENGINE				
Replace rocker box		61		
OIL SYSTEM				
Clean and/or replace oil system filters or strainers			64	
Service oil sytem		51	97	

Task	Aircraft L-19 N=96	L-20 N=90	L-23 N=36	U-1A N=31
AIR INDUCTION & EXHAUST SYSTEM				
Replace air filter screen			61	
ELECTRICAL SYSTEM				
Service battery and check specific gravity			61	
Use radio telephone procedures			61	
OPERATIONS				
Taxi aircraft			64	
Perform ground handling operations	72	68	67	52
Clean and maintain shop equipment	56	67	69	
Handle flammable materials	64	66	64	
Handle fuel handling equipment			67	
CLERICAL ACTIVITIES				
Maintain records	51	66	64	
Identify and tag serviceable & unserviceable parts		60		
FUEL SYSTEM				
Adjust engine idle speed and/or fuel air mixture	51			
Replace fuel system strainers, screen and filters			61	
IGNITION SYSTEM				
Replace spark plugs	51	54		
CONTROLS				
Check engine controls			67	
Adjust engine controls	50	50	67	
USING EQUIPMENT				
Safety and inspect for proper safetying	77	69	69	52

Table 18

Most Common Maintenance Activities of Rotary Wing Repairmen
(Only tasks performed 6 or more times by 50 percent of the men are included)

Task	Aircraft				
	H-13	H-19	H-34	H-21	Generalistic
	N=124	N=73	N=161	N=284	N=243
INSPECTION					
Make postflight inspection	62				
AIRFRAME					
Replace inspection plates and covers	55				51
Perform general service and lubricate aircraft	71	62	52		54
OIL SYSTEM					
Service oil system	68				
IGNITION SYSTEM					
Replace spark plugs	50				
OPERATIONS					
Perform ground handling operations	66		52		54
Clean and maintain shop equipment	54				
Handle flammable materials	66	52	52		
CLERICAL ACTIVITIES					
Maintain records	58				
USING EQUIPMENT					
SSafety and inspect for proper safetying	80	55	60		53

1) No data are presented for the H-23 because the sample contained too few men specializing on this aircraft (only 20) to justify analysis. No data are presented for the H-21 because none of the tasks on the check list had been performed with sufficient frequency by the 284 H-21 repairmen contacted in the field study to meet the criterion for inclusion in the table.

qualified for inclusion in this table. In fact, only among the H-13 Repairmen were there as many as 10 items performed six or more times by 50% or more of the men. The number of items meeting this criterion for the H-19, H-34, and H-21 were, respectively 3, 4, and zero. The "Generalists" represented in the last column, are those repairmen who had worked on a variety of aircraft rather than specializing on one. For the generalists, four items met the criterion for inclusion in the table.

Again it is true that all items appearing in the table are simple or routine in nature. When this table is compared with its counterpart for organizational maintenance personnel (Table 14, on page 39) the following differences emerge: (1) The table as a whole contains fewer items (10 vs. 19); (2) For each aircraft mentioned in the table (except the H-13) the repairmen performed fewer tasks with high frequency than did the mechanics. This was also true for the "generalists."

Supervisors

Table 19 lists all tasks performed six or more times during a three-month period by at least half of the 189 field maintenance supervisors contacted.* This list of tasks appears similar to the lists appearing in the other table. It consists of 10 rather simple tasks. The corresponding table for organizational maintenance personnel consists of 17 tasks which are also rather simple and routine.

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* Forty-five members of this group were actually Technical Inspectors.

Table 19

MOST COMMON ACTIVITIES OF
FIELD MAINTENANCE SUPERVISORS

(Only tasks performed 6 or more times by
50% or more of the men are included)

N = 189

Activity	% Performing 6 or more times
CONTROLS	
Check engine controls	51
AIRFRAME	
Replace inspection plates and covers	56
Replace fairings and fuselage cowlings	51
OIL SYSTEM	
Service oil system	51
OPERATIONS	
Clean and maintain shop equipment	63
Handle flammable materials	59
CLERICAL ACTIVITIES	
Maintain records	81
Identify and tag parts	81
USING EQUIPMENT	
Safety and inspect for proper safetying	77
Apply protective coating and anti-corrosive measures	51

Aircraft Component Repair Personnel

Table 20 shows the most commonly performed tasks of men holding certain MOS's in the aircraft component repair field, i.e., the so-called "68 series" MOS's. Not appearing in this table are data from 31 component repair helpers (MOS 680.0) because of the fact that this group had not performed any tasks with sufficient frequency to meet the criterion for inclusion in the table. The other "68 series" MOS's missing from this table were not included because too few men holding these MOS's were contacted in the field to justify analysis of their data.

Since aircraft component repairmen are trained to specialize in the repair of certain aircraft systems one would expect that each MOS group in this area would show a concentration of activity in tasks related to their area of specialization. The data in Table 20 support this expectation to a limited extent. Many of the high frequency tasks of engine repairmen (MOS 681) appear closely related to the engine system although only one such task is listed under the specific heading of "Power plant, Engine." The aircraft electrician group (MOS 685) shows frequent performance of three tasks pertaining to electric systems whereas the other two MOS groups in this table show no frequent tasks in this system. The airframe repairmen (MOS 686) perform the task "Make minor skin repairs" with high frequency whereas the other two MOS groups do not.

Again it is noteworthy that so few tasks are done with sufficient frequency to meet the criterion for inclusion in the table.

A few of the tasks appear to be somewhat demanding of the

Table 20

MOST COMMON MAINTENANCE ACTIVITIES OF AIRCRAFT COMPONENT REPAIRMEN
(Only tasks performed 6 or more times by 50% or more of the men are included)

Task	MOS 681.1 (Engine) N=47	MOS 685.1 (Electric) N=65	MOS 686.1 (Airframe) N=168
AIRFRAME			
Make minor skin repairs			67
POWER PLANT, ENGINE			
Replace rocker box covers and gaskets	61		
IGNITION SYSTEM			
Replace spark plugs	51		
AIR INDUCTION & EXHAUST SYSTEM			
Replace cowling fasteners			64
Replace engine cowling, ducts, exhaust collection system	60		
Replace air induction & exhaust system plugs, lines, etc.	51		
ELECTRICAL SYSTEM			
Replace lamp bulbs		52	
Operate multimeter		75	
Read wiring diagrams		75	
OPERATIONS			
Clean and maintain shop equipment	53	51	68
Handle flammable material			51
CLERICAL ACTIVITIES			
Identify and tag serviceable and unserviceable parts	51	54	
USING EQUIPMENT			
Safety and inspect for proper safetying	51	54	
Make rivet repairs			75
Apply protective coating & anit-corrosive measures	53		64
Make repairs by soldering		63	

repairman's skill but most appear to be rather simple and routine.

Comparison of Activities of Organizational and Field Maintenance Personnel

It has been evident throughout this chapter and also throughout the previous chapter which was concerned with organizational maintenance personnel, that very few tasks are performed with high frequency and that those that are, are generally organizational level tasks. Substantially the same tasks are performed with high frequency both by mechanics and repairmen.

It might be speculated that these findings are an artifact arising from the particular criterion employed in selecting items to be reported in the tables.[10] To evaluate this possibility, certain other criteria were applied to determine whether the contents of the existing tables would thereby be modified appreciably. For example, data for L-19 mechanics and for L-19 repairmen were reanalyzed and new tables constructed according to each of the following criteria: (a) all items performed 3 or more times by 75% of the men; and (b) all items performed 10 or more times by 30% or more of the men. It was found that with criterion (a) fewer items qualified and with criterion (b), a greater number of items qualified. In each case, however, the particular items listed for repairmen and those listed for mechanics were substantially the same. It is clear, then, that repairmen and mechanics cannot be

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10. The Aviation School and the Transportation School have each been supplied with complete sets of all data relevant to their interests.

differentiated on the basis of the high frequency tasks which they perform.

It is still possible, however, that repairmen and mechanics can be differentiated on the basis of the tasks which each group performs more often than the other, even though neither group performs them with high frequency.

A special analysis (described in Appendix A) revealed that a total of 62 tasks were performed more often by repairmen than by mechanics on at least one of the nine aircraft involved in the study. Only nine of these tasks were clearly identifiable as authorized field maintenance tasks on the basis of the Maintenance Allocation Charts. A total of 51 tasks were performed more often by mechanics than by repairmen. All but one of these were, quite properly, organizational maintenance responsibilities.

It is of interest to determine whether there are certain aircraft systems on which repairmen perform more work than mechanics and vice versa. A special analysis (described in Appendix B) revealed that repairmen were more active than mechanics on the following systems: Controls, Landing Gear, Ignition System, Air Induction & Exhaust System, and Helicopter Controls. Mechanics were more active than repairmen on the following "systems": Inspections, Airframe, Oil System, Electrical System, Operations, Clerical Activities, and Using Equipment. Even though repairmen and mechanics do differ with respect to the systems on which each is more active than the other, the vast majority of individual tasks on which the groups differ are organizational maintenance

responsibilities.

In order to gain a clearer understanding of which personnel actually perform the authorized field maintenance tasks, a variety of analyses were carried out based on just those tasks which are clearly identified in the Maintenance Allocation Charts as field maintenance responsibilities. This was done for the L-19 data, and, in some instances, for the L-20 and the H-13 data as well. These analyses are described in detail in Appendix C. The principal findings resulting from these analyses were as follows:

(1) With respect to all L-19 field maintenance tasks, repairmen were more active than mechanics on 45 tasks; mechanics were more active than repairmen on 30 tasks; and both groups were equally active on 48 tasks. Comparable results were found with respect to the L-20 and the H-13 data.

(2) The tendency for repairmen to be more active than mechanics on L-19 field maintenance tasks was not related to the total frequency with which each task was done. In other words, there was no tendency for the infrequent tasks to be done primarily by repairmen.

(3) The average number of L-19 field maintenance tasks which had been performed by repairmen in a three-month period was 68; the average number performed by mechanics was 39. However, since there were more L-19 mechanics than repairmen in the sample (326 versus 96), this means that the total number of field maintenance tasks actually performed by L-19 mechanics was greater than that performed by L-19 repairmen (12,766 versus 6,575).

The evidence presented in the last few pages, and much of that presented in other sections of this report, indicates that there is considerable overlap in the duty activities of mechanics (men with organizational maintenance MOS's) and of repairmen (men with field maintenance MOS's). The fact that repairmen are as active as they are in the performance on lower echelon tasks is probably explained by the fact that many of these tasks are done merely as steps in gaining access to components requiring higher echelon repair. Others may be in the nature of inspections or tests performed to check upon the quality of higher echelon tasks that have just been completed.

The failure of repairmen to show very high frequency in the performance of any of the higher echelon tasks is probably explained by the following considerations: (1) Since many of these tasks are quite time consuming the number of times that they can be performed by individual repairmen is necessarily small. For example, the task "Replace main rotor head assembly" obviously requires much more time than does the task "Clean plexiglass." It is therefore quite probable that repairmen spend a greater amount of their total work time performing field maintenance tasks than they do performing lower echelon tasks. (2) Since the aircraft in the current inventory are very dependable and relatively trouble free, complex corrective actions are simply not often necessary. If they were, this would probably indicate the need for design changes. (3) It is also possible that the geographical distribution of aircraft, and of aircraft units, is such that repairmen must be continuously available in certain kinds of units

where their relatively high level skills will seldom be employed, but must be available when the need does arise.

A more troublesome question is that of why the lower echelon mechanics are so active in the performance of higher echelon tasks. The most reasonable explanation of this fact is that since repairmen and mechanics so often work in the same units, a great deal of cross-training occurs. From close association with repairmen, mechanics eventually learn to perform many of the higher echelon tasks and are probably required to do so when the repairmens' work load becomes excessive. Table 1 on page 4 shows that each of the listed categories of units contains both organizational and field maintenance MOS's. The entries in Table 1 include not only the independent maintenance personnel but also the helpers and the enlisted supervisors. The number of mechanics in the sample who were assigned to field maintenance organizations was 91; the number of repairmen who were assigned to organizational type units was 199. After examining the TO&E's for many of these units it appeared that most of these men were misassigned.

Another question, and one that cannot be answered by the data obtained in this study, concerns the efficiency with which organizational maintenance personnel carry out higher echelon tasks. It is possible that they are much slower in doing so than the more highly trained repairmen and that they require a good deal of assistance and supervision from the repairman. Probably in most instances repairmen bear responsibility for the proper execution of the work.

It is believed that aviation maintenance authorities should

carefully consider the implications of the finding that lower echelon mechanics are fairly active in the performance of field maintenance tasks. Conceivably, some modification might be called for in the training given to these two categories of personnel, in the assignment of such personnel to different units, and/or in the authorized responsibilities of each. Perhaps some of the field maintenance tasks which mechanics perform without having been formally trained to do so should be added to their authorized responsibilities. This, of course, would require that appropriate additions be made to their formal training programs. Perhaps organizational maintenance doctrine should be modified so as to explicitly provide for the performance of higher echelon tasks by organizational maintenance personnel whenever such work can be supervised by field maintenance personnel. On the other hand, it may be considered desirable to take administrative actions to prevent organizational maintenance mechanics from working beyond their echelon. Another possible course of action would be to improve the efficiency of the personnel distribution system so as to reduce the incidence of misassignment of aircraft maintenance personnel. Finally, it may be the judgment of aviation maintenance authorities that no particular actions are indicated by the finding that organizational maintenance mechanics are relatively active in the performance of field maintenance tasks. Perhaps the present system is doing a satisfactory job of maintaining the Army's aircraft in spite of the fact it does not adhere precisely to the formal administrative regulations.

Chapter 5

EVALUATION OF THE ENTRY COURSES IN AIRCRAFT MAINTENANCE AND AIRCRAFT COMPONENT REPAIR

This chapter is concerned with an evaluation of the Aircraft Maintenance Entry Course (MOS 670.0) and of the Aircraft Component Repair Helper Course (MOS 680.0). Although the latter course no longer exists as a separate entity, Transportation School authorities have indicated that an evaluation of the topics it contained would still be of value to them since most of these topics are now taught in various of the advanced courses.

Because the two courses were highly similar in content, it was possible to construct a single check list, the School Subjects Check List, for evaluating both courses. This research instrument lists all topics of instruction included in the two courses. The topics are organized into the following three groups: (a) those common to both courses; (b) those unique to the 670 course; and (c) those unique to the 680 course. All men contacted who had taken either of these two courses were required to fill out a copy of this form. Data were obtained from 1650 graduates of the 670 course and 690 graduates of the 680 course.[11] It seems quite likely that many of the men who filled out a School Subjects Check List would be unable to make a clear distinction between the training they had received in their helper course and that which

11. These numbers were the projected N's obtained after the CONUS data had been weighted. Actual N's were 984 and 489 respectively for the 670 and 680 graduates.

they had received in a subsequent advanced course. To the extent that this is true, these data may be legitimately interpreted as having implications for aircraft maintenance training in general, not merely for the helper courses.

In filling out the form, the man was required to make certain responses in connection with each relevant topic listed in the form. Specifically, to indicate how valuable for maintenance he considered that topic to have been, he was to mark one of the following response categories: "no value," "some value," "much value," or "great value." If he was unable to recall the topic, he so indicated by making a check mark in an appropriate response category. He was also required to express an opinion concerning the appropriateness of the amount of time that had been spent on each topic in the course by marking one of the following response categories: "Topic could be dropped from the course," "I needed less training on this topic," "Training on this topic was about right," or, "I needed more training on this topic."

These data concerning judged appropriateness of training time will not be analyzed in great detail in this report for the following reasons: (1) Since the 680 course has been discontinued, such judgments would have little meaning with respect to it; (2) In July of 1960, the 670 course was revised rather radically in connection with a general reorganization of the MOS structure in aircraft maintenance. The overall effect of the revision was to reduce the length of the course from eight to five weeks. This meant that most of the topics received less attention than formerly. Therefore, these judgments with respect to appropriateness of training time could have little meaning. (3) In any

event, it was found that topics judged in greatest need of additional training were, by and large, the same topics which were judged to have greatest value for maintenance. Therefore, by directing our attention primarily to the judged value for maintenance, we will learn about the same things that would be learned from a consideration of the judged training needs.

Probably because the two courses are so similar in content and also, perhaps, because field maintenance men and organizational maintenance men have been found to do essentially the same things, we find that the two categories of men evaluated the topics in their respective courses very similarly. It is for this reason that evaluations of both courses are dealt with in this one chapter.

Topics Judged of Most Value in Maintenance

The response categories, "no value," "some value," "much value," or "great value," were assigned score values of 1, 2, 3, and 4 respectively. Mean scores (representing mean value judgments) were computed for each topic. The higher the mean value judgment for a topic, the greater the value for maintenance that topic was considered to have.

Tables 21 and 22, respectively, list the top 20 topics in the 670 course and in the 680 course in terms of mean value judgment. Twelve topics, those marked with an asterisk in each table, are common to both tables. In general, the mean value judgments received by topics in the 670 course are somewhat higher than those received by topics in the 680 course. The highest ranking topic in both courses was "Identification of Minor Engine Malfunctions and Trouble Shooting." In fact, 60% of the

Table 21

Topics in 670.0 Course Judged of Most Value in Maintenance

	Topic	Mean Value Judgment
*1.	Identification of minor engine malfunctions and trouble shooting	3.57
*2.	Familiarization with aircraft magnetos and ignition systems	3.32
3.	Cyclic, collective pitch and tail rotor control systems	3.27
*4.	Introduction to Air Force technical publication system	3.27
5.	Cyclic, collective pitch, and directional conrol systems	3.26
6.	Airplane control systems	3.24
*7.	Discussion of Technical order numbering system	3.23
*8.	Trouble shooting, service, and repair of hydraulic system	3.22
9.	Practical exercise in preparation and maintenance of DD Form 781	3.22
*10.	Types of power trains; components, nomenclature and functioning	3.21
11.	Discussion of procedures in preparation and use of DD Form 781	3.21
12.	Types, use and inspection of safety devices	3.18
*13.	Practical exercises in use of Technical Order indexes	3.18
*14.	Discussion of bearings, bushings, gears, and shafts	3.17
15.	Engine and power train lubrication	3.17
16.	Parts of aircraft and theory of flight	3.16
*17.	Principles of hydraulics	3.16
*18.	Discussion of aircraft instruments and their purpose	3.15
*19.	Familiarization with aircraft generator systems	3.12
*20.	Principles of carburetion	3.11

* Topics marked with an asterisk were judged by both 670 graduates and 680 graduates as among the top twenty in terms of value for maintenance.

Table 22

Topics in 680.0 Course Judged of Most Value in Maintenance

	Topic	Mean Value Judgment
*1.	Identification of minor engine malfunctions and trouble shooting	3.38
*2.	Familiarization with aircraft magnetos and ignition systems	3.24
*3.	Discussion of Technical Order numbering system	3.16
*4.	Types of power trains; components, purposes, etc.	3.16
*5.	Practical exercises in use of Technical Order Indexes	3.15
*6.	Trouble shooting, servicing and repair of aircraft hydraulic systems	3.15
*7.	Discussion of bearings, bushings, gears and shafts	3.14
8.	Procedures and techniques used in cleaning engine and power train components.	3.14
*9.	Principles of hydraulics	3.14
*10.	Introduction to the Air Force Technical publication system	3.11
*11.	Principles of carburetion	3.10
12.	Familiarization with voltmeter, ammeter and ohmmeter	3.10
13.	Carburetor removal, installation and external adjustment	3.10
14.	Safety precautions in aircraft hydraulic systems	3.09
15.	Interpretation of wiring diagrams in aircraft Technical Orders	3.09
*16.	Familiarization with aircraft generator system	3.08
*17.	Discussion of aircraft instruments and their purpose.	3.08
18.	Aircraft engine pistons, pins and rings	3.08
19.	Precision measuring tools	3.07
20.	Removal and installation of aircraft engine cylinders.	3.07

* Topics marked with an asterisk were judged by both 670 graduates and 680 graduates as among the top twenty in terms of value for maintenance,

670 graduates and 46% of the 680 graduates checked this topic as one having "great value" for maintenance. It would appear that one of the most difficult tasks performed by mechanics and repairmen in the field is the diagnosis of minor engine malfunctions. Presumably, grosser malfunctions are more easily diagnosed. In each table there are certain other topics such as "familiarization with magnetos and ignition systems," and "principles of carburetion," which might reasonably be expected to facilitate trouble shooting of minor engine malfunctions. It seems likely that these topics were considered by many men as highly valuable for maintenance for this reason.

Another prominent feature of both tables is the presence of several topics concerned with the use of technical information sources. In Table 21, topics numbered 4, 7, and 13, fit this description. In Table 22, topics numbered 3, 5, 10, and perhaps 15 meet this description.

In Table 21, four topics (items 3, 5, 10, and 15) all pertain to helicopter power trains or control systems.

Topics in Which Men Need Additional Training

Judgments concerning the appropriateness of the time spent on each topic were made by checking one of the following response categories: "I needed more training on this topic," "training on this topic was about right," "I needed less training on this topic," or "topic could be dropped from the course." Percentages of men who checked each response category for each topic were computed.

Since it would be difficult to draw conclusions from such a large mass of data, further analyses were made to obtain a single index of the

extent to which additional training was needed in each topic. Such an index was computed by subtracting from the percentage who said more training was needed, the percentage who said less training was needed, or that topic could be dropped from the course. The resulting index number is referred to as a "net percentage." The larger the net percentage, the greater the judged need for more training. A negative net percentage means that the number of men who said more training was needed was smaller than the number who said less training was needed. In other words, an item with a negative net percentage is one which would appear to need less training time if any changes at all are to be made in the time devoted to the topic.

Tables 23 and 24 respectively, list the top 20 topics in the 670 course and in the 680 course in terms of the net percentage who desired more training and also the absolute percentage who felt that the time devoted to that topic had been "about right." The contents of these two tables resemble each other markedly: 17 topics (those marked with an asterisk) are common to both tables. This fact, of course, is compatible with the conclusion drawn in Chapter 4, namely that organizational and field maintenance personnel do not differ markedly in the kind of maintenance activities they perform.

In making judgments concerning training needs, it was possible for the men to take into account not only the value of each topic for maintenance work but also its value for any other aspect of the job. It appears, however, that judged value for maintenance was the primary factor determining the men's judgment of training needs.

Table 23

Topics in 670.0 Course in Which Greatest Number of Men Expressed Need for Additional Training

	Topic	More Training Needed Net %	Training About Right Absolute %
* 1.	Identification of minor engine malfunctions and trouble shooting	52	43
* 2.	PE in use of Technical Orders Indexes	38	48
* 3.	Familiarization with magnetos and ignition systems	33	57
* 4.	Introduction to Air Force technical publication systems	36	48
* 5.	Discussion of Technical Orders numbering system	36	49
* 6.	Trouble shooting, service and repair of components in aircraft hydraulic systems	34	51
* 7.	Interpretation of wiring diagrams in aircraft TO's	33	57
* 8.	PE in preparation and maintenance of DD Form 781	32	58
* 9.	Familiarization with voltmeter, ammeter, and ohmmeter	31	49
*10.	Discussion of procedures employed in preparation and use of DD Form 781	29	61
11.	Cyclic, collective pitch and directional control system	28	61
12.	Cyclic, collective pitch and directional tail rotor control systems	27	61
*13.	Fundamentals of electricity	27	53
*14.	Types of power trains; components, nomenclature and functioning	26	66
*15.	Discussion of time Compliance Technical Orders and misc. Technical Orders	24	59
16.	Parts of aircraft and theory of flight	24	63
*17.	Principles of carburetion	24	60
*18.	Familiarization with switches, relays, fuzes and circuit breakers	23	60
*19.	Discussion of standard Technical Orders Handbook	22	61
20.	Principles of Hydraulics	22	66

* Topics marked with an asterisk also appear in Table 24 which lists the twenty topics in which graduates of the 680 course felt they were most in need of additional training.

Table 24

Topics in 680.0 Course in which Greatest Number of Men Expressed a need for Additional Training

	Topic	More Training Needed Net %	Training About Right Absolute %
* 1.	Identification of minor engine malfunctions in trouble shooting	45	42
* 2.	Discussion of Technical Orders numbering system	42	41
* 3.	PE in use of Technical Orders Indexes	41	44
* 4.	PE in preparation and Maintenance of DD Form 781	38	51
* 5.	Discussion of Procedures employed in preparation and use of DD Form 781	35	50
* 6.	Introduction to the Air Force Technical publication system	35	41
* 7.	Interpretation of wiring diagrams in aircraft TO's	35	48
* 8.	Familiarization with aircraft magnetos and ignition systems	35	55
* 9.	Familiarization with voltmeter, ammeter and ohmmeter	33	52
*10.	Fundamentals of electricity	32	51
*11.	Principles of carburetion	31	50
*12.	Familiarization with switches, relays, fuses, etc.	31	57
*13.	Trouble shooting, servicing and repair of aircraft hydraulic systems	30	52
14.	Discussion of Technical Orders indexing and filing method	25	50
15.	Discussion of AN numbering system and aircraft hardware, etc.	25	52
16.	Introduction to welding procedures	25	53
*17.	Discussion of Time Compliance Technical Orders and miscellaneous Technical Orders	24	54
*18.	Discussion of standard Technical Orders Handbook	23	58
*19.	Types of power trains; components, purposes etc.	22	64
20.	Discussion of aircraft instruments and their purposes	22	63

*Topics marked with an asterisk also appear in Table 23 which list the 20 topics in which graduates of the 670 course felt they were most in need of additional training.

Fifteen of the 20 topics in Table 23 and all of the 20 topics in Table 24 also appeared in the previous tables which listed the topics judged most valuable for maintenance. The remaining topics in Tables 23 and 24 were ones in which the men felt they needed more training even though they did not consider them to be of outstanding value for maintenance.

The highest ranking item in all tables is "Identification of Minor Engine Malfunctions and Trouble Shooting." It is also evident that graduates of both courses felt a great need for more training in the use of technical information sources. Perhaps they felt that a greater facility in the use of technical publications would assist them in many of their maintenance problems.

The reader is cautioned not to accept uncritically the implication that topics judged in need of additional training should in fact be given greater emphasis. It should be kept in mind that the nature of the research instrument used to collect these data restricted somewhat the kind of information which could be reported. If a man had had difficulty performing certain of his maintenance duties, he would probably indicate a need for more training on whatever topic or topics among those listed in the form appeared to him to be related to his difficulty. It is possible that for some of the maintenance difficulties he had had, no course topic was listed which was closely relevant.

For example, the topic "Fundamentals of Electricity" was regarded by a net percentage of 27% of the 670 graduates and 32% of the 680

graduates as one in which they needed additional training time. This fact probably means that many men had had difficulty in performing electrical repairs. But it does not necessarily mean that additional training in Fundamental of Electricity would solve the problem. It is possible that a different kind of topic in the general are of electricity is needed, possibly one entitled, "Diagnosis and repair of aircraft electrical systems."

In general, it is probably best to assume that any topic judged in need of additional training is one which is at least peripherally related to some maintenance area in which the men had had difficulty. Such topics should be carefully examined to see where instruction might be improved. Improvement, in some instances, might consist of providing more detailed information and at a more moderate pace. In other instances, inprovement might consist of drastically revising the lesson plans so that the topic is taught in an entirely different fashion. It is possible that in some instances an entirely new topic should be added to the POI in an effort to alleviate the maintenance difficulties which presumably are related to it.

Topics Judged of Least Value in Maintenance

Tables 25 and 26, respectively, list the 20 topics in the 670 course and the 20 topics in the 680 course which have the lowest mean value judgments. In other words, these are the topics which the men considered to have the least value for maintenance. It does not follow, however, that these particular topics, or others having a low mean

Table 25

Topics in 670.0 Course Judged of Least Value in Maintenance

	Topic	Mean Value Judgment
1.	Familiarization with parachutes	2.31
*2.	Types and categories of Army rotary and fixed wing aircraft	2.32
3.	Development and layout of a tactical Army airstrip	2.35
*4.	Familiarization with pilots magnetic compass	2.46
*5.	Responsibilities of Dept. of Air Force and Dept. of Army for maintenance of Army aircraft	2.47
*6.	Categories and echelons of maintenance	2.52
7.	Familiarization with operation of Army Aviation Co.	2.55
*8.	Introduction to USAF and Transportation Corps Supply catalog	2.65
*9.	Care and repair of aircraft fabrics	2.65
*10.	Importance of supply economy, etc.	2.66
*11.	Instruction on Unsatisfactory Equipment Reports	2.68
12.	Recovery and evacuation	2.68
13.	Familiarization with inspections of ferrous and non-ferrous materials, application of magnetic particles and penetrant methods	2.72
14.	Basic aircraft crash rescue procedures	2.74
15.	Removing, installing and storing propellers	2.79
16.	Familiarization with principles and terminology of weight and balance	2.79
17.	Radio and telephone procedures	2.79
*18.	Aviation POL products	2.80
19.	Use of protective coating on aircraft	2.81
*20.	Identification and care of plastics	2.81

* Topics marked with an asterisk were judged by both 670 graduates and 680 graduates as among the bottom twenty in terms of value for maintenance.

Table 26

Topics in 680.0 Course Judged of Least Value in Maintenance

	Topic	Mean Value Judgment
1.	Familiarization with Transportation Corps aircraft maintenance units	2.24
*2.	Responsibilities of the Department of Air Force and the Department of Army for maintenance of Army aircraft	2.26
*3.	Types and categories of Army rotary and fixed wing aircraft	2.31
*4.	Familiarization with pilot's magnetic compass	2.42
*5.	Categories and echelons of maintenance	2.49
6.	Discussion of Molecular Theory	2.49
7.	Gravity, and Newton's laws of motion	2.50
8.	Transportation Corps aviation maintenance and supply sytem	2.54
9.	Discussion of quality control	2.59
*10.	Care and repair of aircraft fabric	2.61
11.	Supply procedures	2.61
*12.	Importance of supply economy	2.66
*13.	Aviation POL products	2.68
*14.	Introduction to USAF and Transportation Corps supply catalogue	2.69
*15.	Instruction on Unsatisfactory Equipment Reports	2.69
16.	Technical Order familiarization charts	2.71
17.	Discussion of force, work, power and horsepower	2.74
18.	Blueprint reading	2.75
19.	Principles of operation of propellers	2.77
*20.	Indentification and care of plastics	2.77

* Topics marked with an asterisk were judged by both 670 graduates and 680 graduates as among the bottom twenty in terms of value for maintenance/

value judgment, necessarily have no usefulness in their respective courses. It seems likely that certain topics which are known to have little value for maintenance work per se were included in the courses for other reasons. For example, the topic, "Types and Categories of Army Rotary and Fixed Wing Aircraft" is probably essential in order to give the student an adequate orientation to the job he will ultimately perform. It is probably essential for safety reasons that all men in organizational maintenance units be acquainted with "basic aircraft crash rescue procedures" even though this topic is of no value to maintenance per se. Instruction on such topics as "Unsatisfactory Equipment Reports" and "Importance of Supply Economy" is probably essential even though it is not directly related to maintenance.

There are a number of other topics in both tables which are not obviously related to maintenance and whose usefulness in the courses will have to be assessed by appropriate training authorities. Two examples are "familiarization with parachutes," and "familiarization with pilot's magnetic compass."

Other topics in Table 25 are clearly related to maintenance yet were regarded by the men in the field as having very little value. It seems likely that these topics were so regarded because they pertain to rarely performed maintenance activities. Some examples are: "care and repair of aircraft fabrics," "removing and storing propellers," and "use of protective coating on aircraft." Maintenance Activities Check List data, reported in Chapter 3, indicate that none of these items is done with high frequency.

It will be noted that the contents of Table 26 are highly similar to the contents of Table 25. In fact, 10 of the topics are common to both tables, indicating again the similarity of findings with respect to the 670 and 680 courses.

Topics in which Men Need Less Training

Tables 27 and 28 list for the 670 and 680 courses, respectively, the 20 topics having the smallest net percentages of men who expressed a need for more training. In other words, these are the topics in which the greates number of men in each course felt that they needed less training. It will be recalled that a negative net percentage means that the number of men who desired less training exceeded the number who desired more training. In order to give the reader a better basis for evaluating the net percentage figures, each table also includes the percentage of men who consider the training time devoted to each topic to have been "about right."

These two tables also show a marked similarity to each other. Twelve topics, those marked with an asterisk, are common to both tables. In other words, 670 and 680 graduates agree that they need less training on these particular topics.

It is also worth noting that the tables concerned with training needs are very similar to the corresponding tables concerned with judged value for maintenance. In other words, there was a marked tendency for men to feel that they needed less training in those topics which they consider of least value for maintenance.

Table 27

Topics in 670.0 Course in which Greatest Number of Men Expressed Need for Less Training

	Topic	More Training Needed Net %	Training About Right Absolute %
*1.	Importance of supply economy, etc.	-23	58
*2.	Responsibilities of Department of Air Force and Department of Army for maintenance of Army aircraft	-22	62
3.	Development and layout of a tactical Army airstrip	-19	65
4.	Familiarization with parachutes	-17	66
*5.	Types and categories of Army rotary and fixed wing aircraft	-16	71
*6.	Discussion of proper care and use of hand tools	-13	69
*7.	Care and repair of aircraft fabric	-12	67
*8.	Familiarization with pilot's magnetic compass	-11	68
*9.	Aviation POL products	- 9	77
10.	Familiarization with operation of Army Aviation Ce.	- 8	69
*11.	Removing, installing and storing propellers	- 7	67
*12.	Categories and echelons of maintenance	- 6	65
13.	Use of proptective coating on aircraft	- 6	76
*14.	Cleaning of aircraft and preparation for storage	- 5	71
*15.	Principles of operation of propellers	- 5	72
*16.	Identification and care of plastics	- 5	73
17.	Discussion of shop safety hazards	- 4	73
18.	Introduction to USAF and Transportation Corps supply catalogue	- 3	53
20.	Methods of engine packing and preservation for temporary and indefinite storage	- 1	72
			71

* Topics marked with an asterisk were judged by both 670 graduates and 680 graduates as among the bottom twenty in terms of judged need for additional training.

Table 28

Topics in 680.0 Course in Which Greatest Number of Men Expressed a Need for Less Training

	Topic	More Training Needed Net %	Training About Right Absolute %
1.	Orientation to Transportation Corps	-48	50
2.	Familiarization with Transportation aircraft maintenance units	-31	63
*3.	Responsibilites of the Department of Air Force and Dept. of Army for maintenance of Army aircraft	-24	63
*4.	Importance of supply economy	-23	55
*5.	Aviation POL products	-15	68
*6.	Removing, installing storing propellers	-14	63
*7.	Discussion of proper use and care of hand tools	-13	73
*8.	Cleaning of aircraft and preparation for storage	-13	70
*9.	Types and categories of Army rotary and fixed wigg aircraft	-12	74
10.	Transportation Corps aviation maintenance and supply systems	-12	67
11.	Gravity and Newton's laws of motion	-12	70
12.	Discussion of the molecular theory	-12	62
*13.	Care and repair of aircraft fabric	-11	65
14.	Discussion of quality control	-11	74
*15.	Categories and echelons of maintenance	-10	66
*16.	Principles of operation of propellers	-10	64
17.	Supply procedures	-10	66
*18.	Familiarization with pilot's magnetic compass	- 9	59
19.	Procedures and techniques used in cleaning engines,	-.8	78
*20.	Identification and care of plastics	- 8	78

* Topics marked with an asterisk were judged by both 670 graduates and 680 graduates as amohg the bottom twenty in terms of judged need for additional training.

Two of the topics in Table 28 appear to deal with highly abstract theoretical subjects whose relevance to the practical aspects of maintenance work may be quite remote. Referred to here are topics 11 and 12 dealing, respectively, with "Gravity and Newton's Laws of Motion" and "Discussion of Molecular Theory." If it is considered essential that repairmen receive instruction on such theoretical subjects, it would probably be preferable to integrate such instruction within a maintenance context. By this is meant that such instruction should be introduced only after a maintenance problem is under discussion which clearly cannot be solved without application of such theoretical material.

Several previous HumRRO studies[12, 13] of MOS's outside the aircraft maintenance field have found that men who received their theoretical instruction in a maintenance context became better trouble shooters than do men who had received their theory instruction in the conventional, somewhat abstract manner. It appears that men who are exposed to theoretical material outside of a maintenance context find it more difficult to learn and also tend to have difficulty in applying such theoretical material to the practical maintenance problems on the job.

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12. George H. Brown et al., Development and Evaluation of an Improved Field Radio Repair Course, Technical Report 58, Human Resources Research Office, September 1959.

13. S. James Goffard et al., Basic Electronics for Minimally Qualified Men: An Experimental Evaluation of a Method of Presentation, Technical Report 61, Human Resources Research Office, February 1960.

Finally, it should be noted that with respect to all topics in both Tables 27 and 28, at least 50% of the men considered the training time devoted to these topics to have been about right. There is thus no strong indication that any topic in either course was receiving too much training time. This is in conformity with what is usually found when men are asked to evaluate a course, that is, men seldom feel that they have been excessively trained on any topic; more commonly they feel that they have received insufficient training. The information in Tables 27 and 28 can be of use, however, in identifying those topics whose elimination would be least objectionable when, for whatever reasons, it is desired to shorten a course in which they appear.

Chapter 6

MOST COMMONLY PERFORMED MAINTENANCE TASKS BY AIRCRAFT AND SYSTEM

In the USAREUR-SETAF phase of the field study, direct observations were made of 4550 maintenance tasks as they were being performed. These observations were recorded on the Maintenance Activities Recording Form, described in Chapter 1. This information might be termed equipment oriented rather than man oriented since it does not take into account the MOS or duty position of the man who performed the task. It indicates the relative frequency with which different kinds of tasks are performed on different aircraft - regardless of who performs them. It is probable that this information will be of value to authorities concerned with the training of field and depot maintenance men (who perform maintenance over a greater number of echelons) and perhaps to persons responsible for planning spare parts procurement.

The 4550 maintenance tasks were distributed among the following kinds of aircraft: L-19 (625 tasks), L-20 (297 tasks), L-23 (73 tasks), U-1A (658 tasks), H-13 (540 tasks), H-23 (25 tasks), H-19, (137 tasks), H-34 (2195 tasks). Since the number of H-23 tasks observed was too small (25) to adequately represent H-23 maintenance requirements, these data were not analyzed. No H-21 data were obtained because no H-21 aircraft were in USAREUR at the time of the field study.

Systems Repaired

Table 29, shows, for each aircraft and for all aircraft combined,

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A SURVEY OF ACTIVITIES OF AIRCRAFT MAINTENANCE PERSONNEL.(U)
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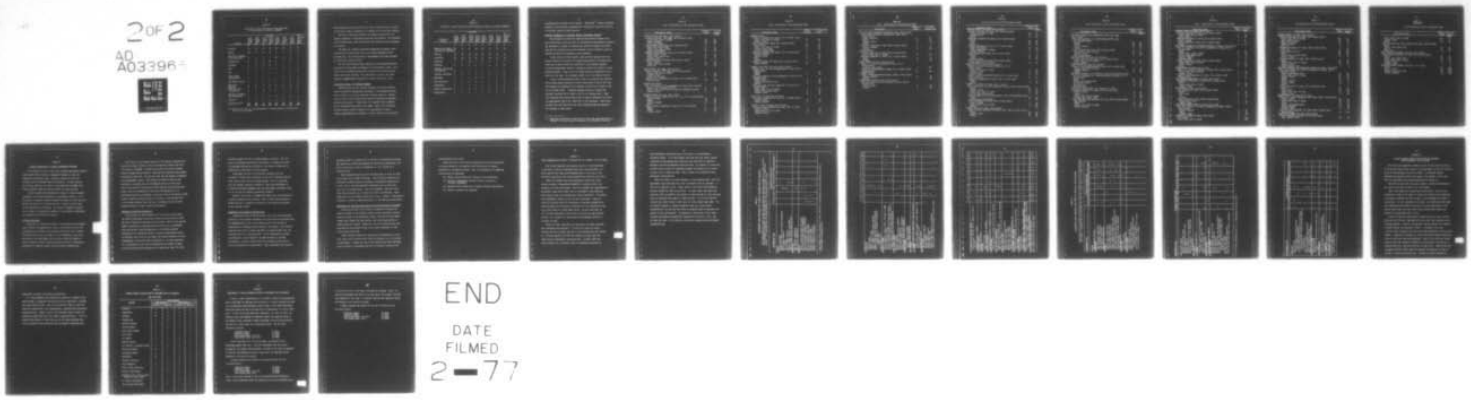

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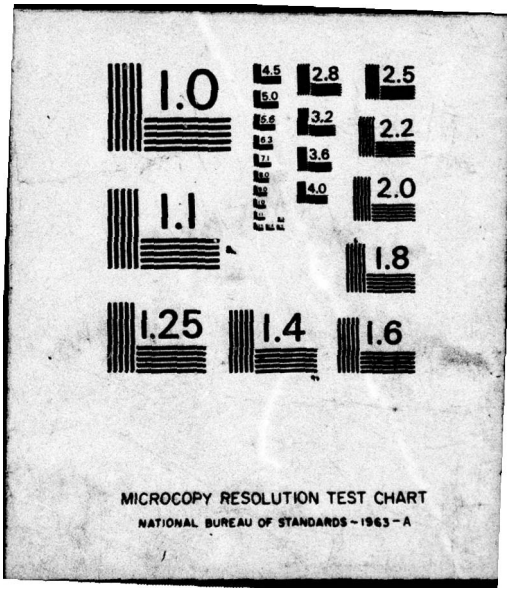
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963 - A

Table 29

Percentage of Total Maintenance Tasks Performed on each System, By aircraft (USAREUR)

System	Aircraft L-19 Total Tasks 625 %	L-20 Total Tasks 297 %	L-23 Total Tasks 73 %	U-1A Total Tasks 658 %	H-13 Total Tasks 540 %	H-19 Total Tasks 137 %	H-34 Total Tasks 2195 %	All Aircraft Total Tasks 4525 %
Airframe	35	32	18	36	10	18	24	26
Engine	10	9	21	12	9	9	8	9
Main Rotor Assembly and Accessories	0	0	0	0	22	12	11	9
Landing Gear	9	12	5	11	1	4	6	7
Controls	9	5	11	10	1	2	2	5
Fuel	6	9	1	5	5	3	3	4
Oil	4	4	1	3	5	7	3	4
Drive System (Helicopter)	0	0	1	0	7	8	6	4
Main Rotor Control	0	0	0	0	4	7	6	3
Hydraulics	1	3	1	3	0	4	4	3
Ignition	2	3	0	3	5	0	3	3
Props and Prop Accessories	3	3	36	5	2	1	2	3
Tail Rotor Assembly and Accessories	0	0	0	0	9	1	4	3
Aircraft	4	1	1	2	3	7	3	3
Miscellaneous [1]/	17/100	19/100	4/100	10/100	17/100	17/100	15/100	14/100

1/ None of the tasks in the miscellaneous category accounted for more than 3% of the total tasks

the percentage of tasks involving each major aircraft system. Systems are listed in order of frequency of encounter for all aircraft combined.

For each of the seven aircraft, the system accounting for the largest proportion of maintenance tasks was the airframe. The subsystems of the airframe most often involved were the fuselage, wings, empennage, and cowling.

The next most commonly encountered system was the engine, which accounted for at least 8 per cent of the tasks performed on each aircraft type, The vast majority of maintenance activities performed on engines were engine run-ups.

For the fixed wing aircraft, landing gear and controls generally accounted for appreciable percentages of the maintenance tasks. Most of the tasks involving controls were concerned with flight controls rather than engine controls. For rotary wing aircraft, main rotor assembly and accessories accounted for numerous maintenance tasks.

Corrective Actions, All Systems Combined

Table 30 indicates the relative frequency with which different kinds of corrective actions were performed on the different aircraft types, without regard to the particular systems worked on. Twenty-four per cent of all the 4525 tasks involved "removing and replacing parts and components." "Inspecting" and "cleaning" each accounted for an additional 18 per cent of the tasks. Most of the corrective actions listed in Table 30 appear to be classifiable as second echelon responsibilities, although, of course, they may quite properly

Table 30

Corrective Actions Involved in 4525 Maintenance Tasks by Aircraft (USAREUR)

Corrective Action	Aircraft							
	L-19 Total Tasks 625	L-20 Total Tasks 297	L-23 Total Tasks 73	U-1A Total Tasks 658	H-13 Total Tasks 540	H-19 Total Tasks 137	H-34 Total Tasks 2195	All Aircraft Total Tasks 4525
	%	%	%	%	%	%	%	%
Removing and replacing parts & components	26	32	8	29	20	17	23	24
Cleaning	15	20	15	16	15	18	21	18
Inspecting	24	24	30	21	17	26	15	18
Adjusting	7	9	33	7	17	8	7	9
Fastening	8	5	5	6	6	4	6	6
Greasing, preserving, lubricating	1	3	1	3	4	2	7	5
Painting, finishing	5	2	0	2	3	5	7	5
Repairing	5	3	4	10	9	3	3	5
Line Operations	2	2	1	2	4	7	4	3
Preparation	2	0	1	2	1	5	4	3
Clerical Activities	2	1	0	1	3	3	2	2
Replenishing	1	0	0	1	1	2	1	1

be performed by personnel at any echelon. "Repairing [14]", which is probably primarily a field echelon responsibility, accounts for only five per cent of the total number of tasks observed.

Detailed Information by Aircraft, System, Subsystem, and Part

The information in Table 29 indicated the relative frequency with which each system of each aircraft was encountered by maintenance personnel. The information in Table 30 indicated the relative frequency with which each kind of corrective action was performed on each aircraft but did not specify the particular subsystem or part involved.

In this section of this chapter, those aircraft systems which were found in Table 29 to account for sizeable proportions of the maintenance tasks done on each aircraft are subjected to more detailed analyses. On the following pages, Tables 31 through 37 present the results of these detailed analyses. They require no comment beyond an explanation of how they are to be read. As an example, Table 31 is to be read as follows:

A total of 625 maintenance tasks on the L-19 aircraft were observed. The airframe system accounted for 216 of these tasks or 35% of the total. The fuselage (a subsystem of the airframe) accounted for 62 tasks or 29% of all airframe tasks. "Cleaning, washing, wiping or scraping the fuselage" accounted for 30 tasks or 48% of all fuselage tasks. Under each subsystem are listed as many kinds of tasks as necessary to account for approximately 75% of all tasks done on that subsystem. Tasks which accounted for less than 10% of the total subsystem tasks are generally not included in these tables.

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14. Repairing was defined as "any activity other than adjustment which is designed to return a malfunctioning part to serviceable condition."

Table 31

L-19: Distribution of 625 Maintenance Tasks

Maintenance Tasks	Number of Tasks	% of Sub System Tasks
AIRFRAME SYSTEM (216 Tasks, 35% of Total)		
Fuselage subsystem (62 tasks, 29% of system tasks)		
Clean, wash, wipe or scrape	30	48
Remove fuselage	13	21
Drill out fuselage	11	18
Wing subsystem (56 tasks, 25% of system tasks)		
Remove and replace wings	23	41
Clean, wash, wipe, scrape	11	20
Adjust and readjust	10	18
Empennafe subsystem (36 tasks, 17% of system tasks)		
Sand, smooth or file	20	56
Clean, wash, wipe scrape	5	14
Inspect, check	4	11
Window Subsystem (29 tasks, 13% of system tasks)		
Remove windows	13	45
Clean, wash, wipe, scrape	10	34
Drill out	4	14
ENGINE SYSTEM (61 tasks, 10% of total)		
Engine subsystem (32 tasks, 52% of system tasks)		
Clean, wash, wipe or scrape	8	25
Inspect, check	8	25
Torque and retorque	7	22
Engine run-up (subsystem) (24 tasks, 39% of system tasks)		
Engine run-up	24	100
LANDING GEAR SYSTEM		
Tail gear wheel and tire subsystem (23 tasks, 40% of system)		
Remove tail gear wheel and tire	9	39
Grease, pack grease seals for tail gear wheels and tires	6	26
Inspect, check	4	17
CONTROLS SYSTEM (59 tasks, 9% of Total)		
Flight controls subsystem F/W-H (53 tasks, 90% of system tasks)		
Inspect, check	19	36
Remove	10	19
Adjust, readjust	9	17
Rivet	6	11
Engine controls subsystem (6 tasks, 1% of system tasks)		
Repair	3	50
Remove	2	33
Inspect, check	1	17

Table 32

L-20: Distribution of 297 Maintenance Tasks

Maintenance Tasks	Number of Tasks	% of Sub-system Tasks
AIRFRAME SYSTEM		
Fuselage, subsystem (52 tasks, 27 % of system tasks)		
Clean, wash, wipe or scrape	18	72
Inspect, check	3	12
Wing subsystem (25 tasks, 27% of system tasks)		
Remove wings	15	60
Clean, wash, wipe or scrape	5	20
Inspect, check wings	4	16
Tighten, loosen wings	1	4
Empennage subsystem (12 tasks, 13% of system tasks)		
Torque, retorque	3	25
Inspect, check	3	25
Rivet	2	17
Replace	2	17
Cowling subsystem (22 tasks, 23% of system tasks)		
Remove cowling	16	73
LANDING GEAR SYSTEM (37 tasks, 12% of total)		
Landing gear, as a whole (subsystem)(11 tasks, 30% of system tasks)		
Modify	6	55
Remove	4	36
Tail gear, wheel and tires subsystem (11 tasks, 30% of system tasks)		
Inspect, check	4	36
Grease, pack grease seals	3	27
Remove	2	18
Main gear wheel and tire subsystem (9 tasks, 24% of system tasks)		
Clean, wash, wipe or scrape	3	33
Grease, pack grease seals	2	22
Inspect, check	2	22
	2	22
FUEL SYSTEM (27 tasks, 9% of total)		
Fuel lines subsystem (12 tasks, 44% of system tasks)		
Inspect, check	6	50
Adjust, readjust	4	33
CONTROLS SYSTEM (15 tasks, 5 % of total)		
Flight controls subsystem (15 tasks, 100% of tasks)		
Inspect, check	9	60
Clean, wash, wipe or scrape	2	20
Tighten, loosen	2	13

Table 33

L-23: Distribution of 73 Maintenance Tasks

Maintenance	Number of Tasks	% of Sub-System task
PROPS AND PROP ACCESSORIES SYSTEM (26 tasks, 36% of total)		
Pitch change mechanism (subsystem)(22 tasks, 85% of system tasks)		
Adjust, readjust	17	77
Repair	3	14
Inspect, check	1	5
Safety	1	5
Propeller subsystem (3 tasks, 12% of system tasks)		
Adjust, readjust	2	67
Install	1	33
AIRFRAME SYSTEM		
Fuselage subsystem (6 tasks, 46% of system tasks)		
Clean, wash, wipe or scrape	6	100
Empennage subsystem (3 tasks, 23% of system tasks)		
Safety	2	67
Replace	1	33
ENGINE SYSTEM (15 tasks, 21% of total)		
Engine as a whole, (subsystem)(4 tasks, 27% of system tasks)		
Inspect, check engine	4	100
Engine run-up(subsystem)(10 tasks, 67% of system tasks)		
Engine run-up	10	100
CONTROLS SYSTEM		
Flight controls(subsystem)(8tasks, 100% of system tasks)		
Adjust, readjust	4	50
Replace	3	38
LANDING GEAR SYSTEM (4 tasks, 5% of total)		
Main gear wheel and tires subsystem (2 tasks, 50% of system tasks)		
Inspect, check	1	50
Install	1	50

Table 34

U-1A: Distribution of 658 Maintenance Tasks

Maintenance Tasks	Number of Tasks	%of Sub-System
AIRFRAME SYSTEM (237 Tasks, 36% of total)		
Fuselage subsystem (67 tasks, 28% of system tasks)		
Clean, wah, wipe or scrape	38	57
Inspect, check	13	19
Remove	9	13
Empennage subsystem (54 tasks, 23% of system tasks)		
Remove	15	28
Rivet	13	24
Repair	10	19
Cowling subsystem (40 tasks, 17% of system tasks)		
Remove and replace	32	80
Clean, wash, wipe or scrape	7	18
Tighten, loosen	1	2
Wing subsystem (36 tasks, 15% of system tasks)		
Remove	12	33
Modify	11	31
Inspect, check	5	14
Window subsystem (18 tasks, 8% of system tasks)		
Clean, wash, wipe or scrape	16	89
ENGINE SYSTEM (81 tasks, 12% of total)		
Engine, as a whole (subsystem)(27tasks, 33% of system tasks)		
Clean, wash wipe or scrape	8	30
Inspect, check	7	26
Remove Engine	5	19
Engine run-up(subsystem)(21 tasks, 26% of system tasks)		
Engine run-up	21	100
Rocker arms subsystem (19 tasks, 23% of system tasks)		
Remove	8	42
Safety	7	37
LANDING GEAR SYSTEM (73 tasks, 11% of total)		
Tail gear wheels and tires subsystem(32 tasks, 44% of system tasks)		
Remove	11	34
Inspect, check	10	31
Clean, wash, wipe or scrape	4	12
Grease, pack grease seals	4	12
Main gear wheel and tire subsystem(27 tasks, 37% of system tasks)		
Remove	16	60
Grease, pack grease-seals	5	19
Struts Subsystem (13 tasks, 18% of system tasks)		
Inspect, check	9	69
Clean, wash, wipe or scrape	2	15
Replace	2	15
CONTROL SYSTEM (63 tasks, 10% of total)		
Flight controls subsystem, F/W-H(63 tasks, 100% of system tasks)		
Repair	30	48
Inspect, check	12	19
Remove	9	14

Table 35

H-13: Distribution of 540 maintenance Tasks

Maintenance Tasks	Number of Tasks	% of Sub-System
MAIN ROTOR ASSEMBLY AND ACCESSORIES SYSTEM (120 tasks, 22% of total)		
Main rotor assembly, as a whole(subsystem)(82 tasks, 68% of system tasks)		
Rebuild	25	30
Remove	18	22
Adjust, readjust	9	11
Safety	8	10
Blade suspension(35 tasks, 29% of system tasks)		
Clean, wash, wipe or scrape	18	51
Inspect, check	7	20
Remove and replace	4	11
AIRFRAME SYSTEM (52 tasks, 10% of total)		
Fuselage subsystem (33 tasks, 63% of system total)		
Clean, wash, wipe or scrape	21	64
Paint, repaint	5	15
ENGINE SYSTEM (46 tasks, 9% of total)		
Engine as a whole(subsystem)(19 tasks, 41% of system tasks)		
Clean, wash, wipe or scrape	6	32
Tighten, loosen	4	21
Remove	4	21
TAIL ROTOR ASSEMBLY AND ACCESSORIES SYSTEM(51 tasks,9% of total)		
Tail rotor assembly, as a whole(subsystem)(41 tasks, 30% of system tasks)		
Safety	88	20
Grease, pack grease seals	6	15
Adjust and readjust	6	15
Rig controls	6	15
Inspect, check	6	15
DRIVE SYSTEM (HELICOPTER) (40 tasks,7% of total)		
Shafting subsystem (17 tasks, 42% of system tasks)		
Inspect, check	8	47
Remove	3	18
Clean, wash, wipe or scrape	2	12
Grease, pack grease seals	2	12
Tail rotor gear box subsystem (15 tasks, 38% of system tasks)		
Rig controls	5	33
Remove	3	20
Clean, wash, wipe or scrape	2	13
Adjust, readjust	2	13

Table 36

H-19: Distribution of 137 Maintenance Tasks

Maintenance Tasks	Number of Tasks	% of Sub System Tasks
AIRFRAME SYSTEM (24 tasks, 18% of total)		
Fuselage subsystem (8 tasks, 33% of system tasks)		
Clean, wash, wipe or scrape	5	62
Paint repaint	2	25
Empennage Subsystem (5 tasks, 21% of system tasks)		
Paint, repaint	5	100
Cowling subsystem (6 tasks, 25% of system tasks)		
Remove	6	100
MAIN ROTOR ASSEMBLY AND ACCESSORIES SYSTEM (17 Tasks, 12% of Total)		
Main rotor assembly, as a whole (subsystem) (2 tasks, 41% of system tasks)		
Safety	2	29
Clean, wash, wipe or scrape	1	14
Grease, pack grease seals	1	14
Adjust, readjust	1	14
Prepare, ready	1	14
Blades subsystem (10 tasks, 59% of system tasks)		
Clean, wash, wipe or scrape	6	60
Fold or unfold	2	20
Track	1	10
ENGINE SYSTEM (12 Tasks, 9% of total)		
Engine, as a whole (subsystem) (3 tasks, 25% of system tasks)		
Clean, wash, wipe or scrape	2	67
Inspect, check	1	33
Engine run-up (subsystem) (9 tasks, 75% of system tasks)		
Engine run-up	9	100
DRIVE SYSTEM (HELICOPTER) (11 Tasks, 8% of Total)		
Transmission subsystem (7 tasks, 64% of system tasks)		
Remove	3	43
Clean, wash, wipe or scrape	2	29
Inspect, check	2	29
OIL SYSTEMS (9 tasks, 7% of total)		
Tank subsystem (6 tasks, 67% of system tasks)		
Safety	2	33
Wax, polish	1	17
Oil	1	17
Install	1	17
Lines subsystem (2 tasks, 22% of system tasks)		
Purge, drain, bleed	1	50
Inspect, check	1	50
MAIN ROTOR CONTROL SYSTEM (9 tasks, 7% of total)		
Main rotor control, as a whole (subsystem) (9 tasks, 100% of system tasks)		
Adjust, readjust	3	33
Remove	3	33
Inspect, check	2	22
AIRCRAFT AS A WHOLE (9 Tasks, 7% of total)		
Tow aircraft	8	(89)
Clean, wash, wipe or scrape	1	(11)

Table 37

H-34: Distribution of 2195 Maintenance Tasks

Maintenance Tasks	Number of Tasks	% of Sub System Tasks
AIRFRAME SYSTEM (531 Tasks, 24% of Total)		
Fuselage subsystem (255 tasks, 48% of system tasks)		
Clean, wash, wipe or scrape	172	67
Sand, smooth or file	51	20
Remove and replace	11	4
Inspect, check	8	3
Drill out	6	2
Empennage subsystem (110 tasks, 21% of system tasks)		
Drill out	31	28
Sand, smooth or file	22	20
Remove	21	19
Clean, wash, wipe and scrape	20	18
Inspect, check	7	6
Cowling subsystem (64 tasks, 12% of system tasks)		
Remove	35	55
Clean, wash, wipe, or scrape	18	28
Inspect, check	4	6
Sand, smooth or file	3	5
MAIN ROTOR ASSEMBLY AND ACCESSORIES SYSTEM (252 tasks, 11% of total)		
Main rotor assembly as a whole (subsystem) 176 tasks, 70% of subsystem tasks)		
Grease, pack grease seals	51	29
Clean, wash, wipe or scrape	41	23
Inspect, check	34	19
Remove	17	10
Adjust, readjust	8	5
Prepare, ready	11	6
Safety	6	3
Blades subsystem (75 tasks, 30% of subsystem tasks)		
Remove	25	33
Fold, unfold	17	23
Clean, wash, wipe or scrape	14	19
Inspect, check	9	12
ENGINE SYSTEM (171 tasks, 8% of total)		
Engine, as a whole (subsystem) (118 tasks, 69% of system tasks)		
Inspect, check	22	19
Clean, wash, wipe or scrape	19	16
Remove	15	13
Grease, pack grease seals	14	12
Adjust, readjust	14	12
Prepare, ready	9	18
Engine run-up (subsystem) (35 tasks, 20% of system tasks)		
Engine run-up	35	100
LANDING GEAR SYSTEM (130 tasks, 6% of total)		
Struts subsystem (73 tasks, 56% of system tasks)		
Sand, smooth or file	24	33

Table 37
(Continued)

H-34: Distribution of 2195 Maintenance Tasks

Maintenance Tasks	Number of Tasks	% of Sub System Tasks
Clean, wash, wipe or scrape	20	27
Inspect, check	11	15
Remove	10	14
Main gear wheel and tires subsystem (38 tasks, 29% of system tasks)		
Grease, pack grease seals	13	34
Remove	10	26
Mask, tape	6	16
DRIVE SYSTEM (HELICOPTER) (138 tasks, 6% of Total)		
Transmission subsystem (78 tasks, 54% of system tasks)		
Remove	25	33
Grease, pack grease seals	12	16
Clean, wash, wipe or scrape	11	15
Prepare, ready	7	9
Inspect, check	6	8
MAIN ROTOR CONTROL SYSTEM (127 tasks, 6% of total)		
Remove	47	(37)
Inspect, check	29	(23)
Grease, pack grease seals	14	(11)
Adjust, readjust	12	(9)

Chapter 7

TRAINING SUGGESTIONS OF AIRCRAFT MAINTENANCE OFFICERS

It was planned to have a copy of the Aircraft Maintenance Officer's Questionnaire filled out by an appropriate officer in each unit visited by the research team. Actually, although 76 units were visited, only 46 completed forms are available. In many instances the form was left with an officer to be mailed back to HumRRO after being completed; often the officers failed to return the form.

The 46 completed forms constitute a sample of unknown representativeness of the entire population of maintenance officers. It is not known, for example, whether officers who failed to return the form differ from those who did return the form in regard to their ideas for the improvement of training. The reader is therefore cautioned not to regard the information presented in this chapter as reflecting the consensus of all aircraft officers.

On-the-Job-Training

When asked to estimate the amount of time required by the typical school trained maintenance man to reach a satisfactory level of job proficiency, most officers gave estimates between two and 18 months. The median estimate was six months. It is interesting to note that six months is the same figure that has been obtained by HumRRO in several studies in which a similar question was asked of maintenance supervisors in Ordnance, Signal and Anti-aircraft organizations.

With regard to the optimum division of the training responsibility between the formal schools and OJT, about half the officers felt that both should be extended. Fifteen per cent felt that school training should be longer and OJT shorter. Seven per cent favored shorter sbbool training and longer OJT. Ten per cent felt that the present arrangement was approximately correct. Each officer was asked to describe the procedure he generally used for introducing new men to their jobs. About three fourths of the officers (74%) reported that they generally assign a new man immediately to work under the supervision of an experienced mechanic or repairman. About one third of the officers (30%) arrange scheduled training classes for new men. A few officers (15% of the group) mentioned that they try to encourage new men to study Technical Orders and other relevant publications.

Judgments of Training Deficiencies

All but three of the 46 officers felt that there were at least a few subject matter areas in which the typical school graduate is weak. The area of deficiency mentioned by the greatest number of the officers (52%) was knowledge of administrative procedures such as completing forms and records, requisitioning parts, and ordering supplies. Evidentally, the maintenance officers consider administrative duties an important part of the job and expect the school graduate to be more knowledgeable in this area than he generally is. In this connection it is interesting to note that the average man who filled out Background Information Form estimated that he spent only about 7 % of his

aircraft related work time on administrative activities. This low rate of performing administrative procedures is probably due partly to knowledge deficiencies and partly to the failure of many men to appreciate the importance of record keeping.

Forty-eight per cent of the officers commented upon the inadquacy of recent school graduates in the use of technical publications, such as TM's, TO's and supply manuals. This is consistent with the finding, reported in Chapter 5, that large percentages of aircraft maintenance personnel felt that they needed additional training in the "use of technical information sources."

Numerous other areas of alleged deficiency were each mentioned by a small percentage of the officers. None of these were mentioned by enough officers to suggest the existence of any serious shortcoming in the training courses.

Suggestions for Changes in MOS Structure

Fifty-two per cent of the 46 officers felt that the existing MOS structure in the aircraft maintenance and repair fields was satisfactory. The remaining 48 per cent of the officers made a wide variety of suggestions for changing various details of the system. Five officers suggested that fixed or rotary wing MOS's be further broken down into different MOS's for special aircraft. (This incidentally, has been accomplished in recent changes in the MOS structure in aircraft maintenance.) Several officers felt that stricter quality control should be exercised in awarding MOS's. They recommended that aircraft

maintenance MOS's be awarded only on the basis of appropriate training and experience, possibly supplemented by proficiency examinations, but never on the basis of rank or assignment to a job calling for a particular MOS.

Many suggestions dealt not with the MOS system, as such, but with the broader area of TO&E composition. Three officers suggested that additional personnel should be assigned to maintenance organizations to take care of all non-maintenance activities such as motor pool, tool room, and supply duties. Such an arrangement, they felt, would allow the maintenance men to devote full time to maintenance. Other suggestions were for adding certain MOS's, e.g., a welder, a publications librarian, a technical supply specialist, or for deleting certain MOS's.

Suggestions for Improving Motivation of Aircraft Maintenance Personnel

Fifty-six per cent of the officers recommended increasing the number of levels in the promotion system, making advancement possible only as a result of job proficiency, and/or providing for more awards (higher pay, "wings" and other medals, crew chief appointments) as higher levels are reached. Twenty per cent of the officers felt that motivation would increase for men in the field maintenance if they could receive flight pay.

Three officers stressed the importance of assigning men to jobs where their school acquired skill would be utilized, i.e., of avoiding mis-assignment. Fifteen per cent of the officers felt that motivation would be better if maintenance men would be relieved of work of the

non-maintenance type duties.

Thirty per cent of the officers expressed the view that motivation is closely related to job capacity; that the best way to improve motivation is to improve training. Among the suggestions for imppoving training were the following:

(1) Tailor course content more closely to job requirements;

(2) Include in maintenance officers course a few hours on personnel management;

(3) Eliminate from courses men not meeting "minimum requirements"

(4) Restrict courses to RA personnel.

APPENDIX A

TASKS PERFORMED MORE OFTEN BY REPAIRMEN THAN BY MECHANICS AND VICE VERSA

Even though repairmen and mechanics could not be differentiated on the basis of the high frequency tasks which they performed, it is still possible that they can be differentiated on the basis of the particular tasks which each group performed more often than the other.

There are probably some field maintenance tasks which, while seldom necessary, are generally performed by repairmen rather than mechanics, when the need arises. There are probably some organizational maintenance tasks which, while they are performed to some extent by both groups of men, are performed more often by mechanics. To evaluate this possibility, Tables A-1 and A-2 were constructed. Table A-1 lists all tasks for which the percentage of repairmen exceeded by at least 15 points the percentage of mechanics who had performed the task six or more times in a three month period. Opposite each task, an "x" is placed under each of the aircraft for which the 15% criterion was met. An "x prime" (x') means that the percentages differed by 30 points or more.

Table A-1, then, identifies the tasks which repairmen performed more frequently than mechanics. A total of 62 tasks are listed, although for most of these, only one or two aircraft have been checked. It is readily apparent that the vast majority of these tasks are organizational maintenance responsibilities. In fact, only nine (those marked with an asterisk) could be positively identified as

field maintenance responsibilities on the basis of the Maintenance Allocation Charts. It is thus evident that even with this rather lenient criterion for determining which tasks are done more often by repairmen, extremely few field maintenance tasks are found. If attention is restricted to those tasks on which the repairmen exceeded the mechanics by 30 points or more, only 15 tasks are found. None of these is an authorized field maintenance responsibility.

Table A-2, which is closely analogous to the preceding table, lists the maintenance tasks performed more often by mechanics than by repairmen. A total of 51 tasks are listed. Tasks common to both tables have different aircraft checked for them in each table. In other words, some tasks were done more often by mechanics with respect to some aircraft but were done more often by repairmen with respect to other aircraft. As would be expected, virtually all tasks listed in this table are lower echelon type tasks. One noticeable exception is "Replace pushrods" which is a third echelon responsibility, but was done more often by mechanics than by repairmen with respect to the L-23 aircraft. If attention is restricted to those tasks on which the mechanics exceeded the repairmen by 30 points or more, only 16 tasks are found. All of these are authorized organizational maintenance responsibilities.

TABLE A-1

MAINTENANCE TASKS PERFORMED MORE OFTEN BY REPAIRMEN THAN BY MECHANICS

Only those tasks are listed on which the percentage of repairmen exceeded by at least 15 points the percentage of mechanics who had performed the item six or more times in a three-month period. (x' indicates that the group differed by 30 percentage points or more)

MAINTENANCE TASK	AIRCRAFT FOR WHICH TRUE							
	L-19	L-20	L-23	U-1A	H-13	H-19	H-34	H-21
CONTROLS								
Replace fairleads				x				
Replace Flt control cable quick disconnects			x'					
Check engine controls			x'					
Rig controls			x'					
Adjust engine controls			x'	x				
*Replace flight control screw jacks				x				
Replace flight control push-pull rods				x				
INSPECTIONS				x				
Make periodic inspections			x'					
Make special inspections			x'					
AIRFRAME								
Replace inspection plates and covers			x'					
Spot paint aircraft and/or assemblies				x				
Replace fairings & fuselage cowlings	x	x	x'					
Remove & install cabin doors	x	x						
*Replace horizontal stabilizer	x							
Replace ailerons & flaps	x	x						
Replace rudders & elevators	x							
Replace upholstery assemblies				x				

* Items marked with an asterisk are those identified in Maintenance Allocation Charts as third or fourth echelon responsibilities.

	L-19	L-20	L-23	U-1A	H-13	H-19	H-34	H-21
LANDING GEAR								
Service			x'					
Replace wheels			x'					
Replace tires & tubes			x'					
Clean, inspect, repack wheel bearings			x'					
Replace brake discs & brake frintion shoes		x	x					
Cycle landing gear for freedom of movement & proper travel			x					
Check shock strut			x					
HYDRAULIC SYSTEM								
Replace hydraulic lines, hoses, fittings & clamps						x	x	
Service hydraulic system		x						
Replace actuating cylinders of wing flap system				x				
Replace ratchet & relief valves, filters, selector valves, control unit of wing flap system				x				
POWER PLANT, ENGINE								
*Replace pushrods		x						
Replace rocker box covers & gaskets		x						
Check engine compression			x					
Replace air baffles & air deflectors	x							
Replace air intake pipes & gaskets			x					
UTILITY SYSTEM								
Install oxygen equipment			x'					
Replace oxygen equipment			x					
FUEL SYSTEM								
Adjust engine idle speed and/or fuel-air mixture	x							
OIL SYSTEM								
Clean and/or replace magnetic plugs, gaskets, etc.		x	x					
Drain & clean oil cooler			x					
Service oil system			x					
IGNITION SYSTEM								
Time & synchonize magneto		x						
Replace magneto		x						
Replace magneto points			x					
Replace spark plugs		x	x					
Replace P-lead connectors & condensers			x					
Replace magneto breaker assemblies, switches, P-leads			x					

	L-19	L-20	L-23	U-1A	H-13	H-19	H-34	H-21
AIR INDUCTION AND EXHAUST SYSTEM								
Replace engine cowling, ducts, exhaust collector sections	x	x						
Replace air filter screen			x'					
INSTRUMENT SYSTEM								
Replace instruments	x							
OPERATIONS								
Load & tie loads			x					
Clean & maintain shop equipment		x	x					x
CLERICAL ACTIVITIES								
Identify & tag service. & unservic. parts		x			x			
USING EQUIPMENT								
Apply protective coating & anti-corrosive measures								x
PROP AND PROP ACCESSORIES								
*Replace spinner assembly (S)			x'					
Make minor repairs to blades not requiring balance (S)			x					
CONTROLS (HELICOPTER)								
*Replace main rotor head assembly					x			
Track main rotor blades					x			
*Replace main rotor blades					x			
*Replace tail rotor blades					x	x		
Torque main rotor head retaining nut					x			
DRIVE SYSTEM (HELICOPTER)								
*Replace drive shafting, drive shaft bearings, and flanges						x		
ELECTRICAL SYSTEM								
Replace battery	x	x						
Clean battery, vent lines, starter, generator			x					
HYDRAULIC SYSTEM, CYCLIC CONTROL, HYDRAULIC BOOST SYSTEM								
*Replace reservoirs, dampers, regulators, restrictors, valves, servos, actuating cylinders						x		
Total number of tasks, by aircraft	11	14	32	7	6	3	1	3
Total number of 3rd or 4th echelon tasks	1	1	1	1	3	1	0	0

TABLE A-2

MAINTENANCE TASKS PERFORMED MORE OFTEN BY MECHANICS THAN REPAIRMEN

(Only those tasks are listed on which the % of mechanics exceeds by at least 15% points the percentage of repairmen who had performed the item six or more times in a 3-month period.)

MAINTENANCE TASK	AIRCRAFT FOR WHICH TRUE							
	L-19	L-20	L-23	U-1A	H-13	H-19	H-34	H-21
CONTROLS								
Check engine controls						x		x
INSPECTIONS								
Make preflight inspections	x	x		x'	x	x'	x'	x'
Make postflight inspections				x		x'	x'	x'
Make periodic inspections	x			x'				
Make special inspections						x		x
AIRFRAME								
Replace static ground wire			x					
Replace engine access doors								x
Clean interior and exterior	x			x	x'	x'	x'	x'
Replace inspection plates and covers						x		x
Perform general service & lubricate aircraft	x			x	x	x	x	x'
Spot paint aircraft and/or assemblies							x	
Replace fairings & fuselage cowlings						x		x
Clean plexiglass	x	x		x'	x	x'	x'	x'
LANDING GEAR								
Patch inner tubes						x		
Service shock strut				x				
HYDRAULIC SYSTEM								
Bleed hydraulic system			x					
Replace wheel brake assemblies			x					
Replace stationary & piston actuated linings and brake disks			x					
Service hydraulic flight control system						x		
Service hydraulic systems								x

MAINTENANCE TASK	AIRCRAFT FOR WHICH TRUE							
	L-19	L-20	L-23	U-1A	H-13	H-19	H-34	H-21
POWER PLANT, ENGINE								
Replace rocker shaft seals				x				
Replace pushrod housing and seal			x'					
*Replace pushrods			x					
Replace rocker box covers and gaskets			x					
Make minor repairs to air baffles and air deflectors			x					
FUEL SYSTEM								
Replace strainers, etc.						x		
OIL SYSTEM								
Clean and/or replace oil system magnetic plugs, gaskets, drains, fittings, clamps								x
Replace oil filler cap								x
Service oil system	x	x		x'		x	x	x'
IGNITION SYSTEM								
Time and synchronize magneto		x						
ELECTRICAL SYSTEM								
Replace battery sump jar and pads								x
Service battery sump jar				x		x		x'
Replace lamp bulbs				x				x'
Service battery and check specific gravity	x							x
Replace landing lights and searchlight, navigation and position lights, and interior lights								x
Replace light lenses								x
Use radio telephone procedures	x	x		x				
Clean battery, vent lines, starter, generator						x		

* A 3rd echelon responsibility acc. to Maintenance Allocation Chart

MAINTENANCE TASK	AIRCRAFT FOR WHICH TRUE							
	L-19	L-20	L-23	U-1A	H-13	H19	H-34	H-21
OPERATIONS								
Taxi aircraft	x	x'		x'				
Operate, inspect & service auxiliary ground handling equipment			x'	x				
Perform ground handling operations (leveling, Jacking, hoisting, towing, mooring, parking, of aircraft)			x					x
Load and tie loads				x'		x	x	x'
Clean and maintain shop equipment				x				
Handle flammable materials			x	x'				
Handle fuel handling equipment			x			x		
CLERICAL ACTIVITIES								
Maintain records	x		x	x'		x'	x	x
Identify and tag serviceable & unserviceable parts			x					
USING EQUIPMENT								
Safety and inspect for proper safetying				x		x		x
Apply protective coating and anti-corrosive measures			x					
OIL SYSTEM (Helicopter)								
Clean and/or replace oil screens						x		
DRIVE SYSTEM (Helicopter)								
Service transmission								x'
Service all gear boxes						x		x

APPENDIX B

AIRCRAFT SYSTEMS WORKED ON MORE OFTEN BY REPAIRMEN THAN BY MECHANICS AND VICE VERSA

The tasks which appeared in Tables A-1 and A-2 were listed according to the aircraft system they involved, following rather closely the divisions set up in the Maintenance Allocation Charts. To determine whether repairmen and mechanics differ with regard to the systems on which their work is concentrated, the following analysis was carried out.

Each task in each table was given a number or weight corresponding to the number of aircraft for which "x's" were listed.

Next, item weights were summed within each system. Each such sum represents an index of the extent to which that category of men (repairmen or mechanics) exceeded the other category in the performance of tasks in that system. Two such computations were made: one based upon those tasks which differentiated between the groups by 15 percentage points or more and the other based upon those tasks which differentiated between the groups by 30 percentage points or more.

Table B-1 shows the index numbers yielded by each of these criteria. Using the 15% criterion, repairmen were more active than mechanics on the following systems: Controls, Landing Gear, Ignition System, Air Induction & Exhaust System, and Helicopter Controls. According to the same criterion (15%), mechanics were more active than repairmen on the following systems: Inspections, Airframe, Oil System, Electrical System, Operations, Clerical Activities, and Using Equipment. (Most of the electrical system tasks on which the mechanics exceeded were quite simple in nature; e.g., checking batteries, replacing batteries or lamp bulbs.) Applying the more stringent criterion (30%), repairmen exceeded the mechanics on only two systems: Controls and Landing Gear. Mechanics exceeded repairmen on

Inspections, Airframe, Oil System and Operations.

It is thus apparent that repairmen and mechanics do differ in the general kinds or categories of tasks which each, respectively, performs more often than the other. Most of the individual tasks on which the mechanics exceeded were, quite appropriately, organizational maintenance responsibilities. However, most of the individual tasks on which the repairmen exceeded were also lower echelon responsibilities. It will be recalled (from Table A-1) that only nine of the tasks performed more often by repairmen were authorized field maintenance responsibilities.

Table B - 1

SYSTEMS WORKED ON MORE OFTEN BY REPAIRMEN THAN BY MECHANICS AND VICE VERSA

Systems	Index Numbers			
	15% criterion		30% criterion	
	Mechanics	Repairmen	Mechanics	Repairmen
Controls	2	9	0	5
Inspections	15	2	8	2
Airframe	26	12	9	2
Landing Gear	2	8	0	4
Hydraulic System	5	5	0	0
Utility System	0	2	0	1
Power Plant, Engine	5	5	1	0
Fuel System	1	1	0	0
Oil System	8	4	2	0
Ignition System	1	7	0	0
Air Induction & Exhaust System	0	3	0	1
Electrical System	14	3	2	0
Instrument System	0	1	0	0
Operations	16	4	6	0
Clerical Activities	7	2	2	0
Using Equipment	4	1	0	0
Props & Prop Accessories	0	2	0	1
Controls (Helicopter)	0	6	0	0
Hydraulic Lift, Cyclic Control, Hydraulic Boost System	0	1	0	0
Oil System (Helicopter)	1	0	0	0
Drive System (Helicopter)	3	1	1	0

APPENDIX C

PERFORMANCE OF FIELD MAINTENANCE TASKS BY REPAIRMEN AND BY MECHANICS

To gain a better understanding of the extent to which field maintenance work is performed by repairmen and by mechanics, a special analysis was made of all authorized field maintenance tasks listed in the Common Maintenance Activities Check List and in the Specific L-19 Maintenance Activities Check List. A total of 123 such tasks were identified. For each of these, the frequency data were examined to determine whether the repairmen group or the mechanic group contained a higher percentage of men who had performed the task six or more times in a three-month period. The following tabulation resulted:

Repairmen higher:	45 tasks
Mechanics higher:	30 tasks
Both groups equal, not zero:	12 tasks
Both groups equal, both zero:	36 tasks

It was noted that on 77 of the 123 tasks, the mechanics had a percentage greater than zero. Absolute percentages were quite small throughout; the largest being 19% which occurred on two items by repairmen. On only one item (Replace horizontal stabilizer) did repairmen exceed mechanics by as much as 15 points.

A similar analysis was carried out for the H-13 data with the following results:

Repairmen higher:	60 tasks
Mechanics higher:	29 tasks
Both groups equal, not zero:	9 tasks
Both groups equal, zero:	19 tasks

Thus, on only about one-half of the H-13 authorized field maintenance tasks, did the repairmen exceed the mechanics by even one percentage point.

On about one-fourth of the tasks, the mechanics exceeded. Again, the absolute percentages were found to be quite small; the largest being 32% (for repairmen on one item). On only six items did the repairmen exceed the mechanics by as much as 15 points.

A similar analysis was carried out for the L-20 data with the following results:

Repairmen higher:	39 tasks
Mechanics higher:	46 tasks
Both groups equal, not zero:	13 tasks
Both groups equal, zero:	24 tasks